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# Factors Underlying
# Changes in Physician Productivity

Deliverable 5C (3)
Final Productivity Report:
Updating and Refinement of the Health
Professions Requirement Model
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# 1.0 INTRODUCTION

## 1.1 Motivation and Purpose of the Study

Currently, the BHPr model predicts the future supply of physician services assuming that physician productivity is constant over time. This assumption is unreasonable for two main reasons. First, if current trends continue, physician work effort will decrease in the future. Second, rapidly changing practice arrangements (e.g., Alternative Health Plans (AHPs) including HMOs) have further implications for both physician work effort and visits per hour above and beyond any general secular trend.

Declines in physician productivity can be explained by a number of underlying factors. For example, since female physicians are known to see fewer patients per year than male physicians, the increasing proportion of female physicians undoubtedly explains part of the productivity decline. Also, theory predicts that an increase in outside income reduces work effort. Thus, the rise in the number of two-earner families over the past decade is likely to have reduced physician work effort. The HMO practice setting (and group practice in general) is associated with lower work effort as well, although work effort effects may be outweighed by the increased visit intensity (visits per hour) in these settings, such that annual productivity (measured as visits per year) may actually increase. Further, increased use of non-physician inputs (including aides and capital) could also lead to higher future productivity.

The purpose of this report is to examine changes in productivity over the past decade and to identify the main factors underlying physician productivity that may be responsible for those changes. Determining the relative impacts of practice and physician characteristics on productivity will aid in estimating future physician productivity. In particular, this effort seeks to isolate the impacts of practice size on productivity from the impacts of practice organization and setting, using recently collected data on physician participation in Alternative Health Plans (AHPs).

## 1.2 Summary of Key Findings

Simple descriptive statistics showing trends in physician productivitiy over the past decade reveal that for most major specialties, annual productivity has indeed declined. In the office setting, this decline was the result of decreased visit intensity rather than decreased work effort. Increases in administrative activity (presumably taking place in the office setting) may explain the small decreases in office work effort. Declines in annual productivity in the hospital setting are primarily the result of decreases in work effort (especially between 1975 and 1978) and the result of both intensity and work effort decreases in the later years.

The results of the descriptive cross-sectional analysis, limited to one way tabulations, showed that variation in visit intensity and work effort generally move in the same direction (e.g., more aides and equipment are associated both with higher intensity and work effort). When they move in opposite directions, the net impact on annual productivity generally depends on the type of variable being analyzed. For example, higher visit intensity by group practitioners dominates their lower work effort for an increase in annual productivity. On the other hand, lower work efforts of physicians with outside incomes of more than $10,000 (presumably from working spouses) generally dominates their higher visit intensity, resulting in lower annual productivity for these physicians. Although the descriptive results for AHP participation were ambiguous, AHP participants appeared slightly more productive overall than non-participants. Further descriptive analysis decomposing AHP participation into HMO, IPA and PPO participation showed that higher productivity was due primarily to higher productivity of IPA participants.

Female physicians appeared less productive overall, although controlling for specialty in the office setting, their lower annual productivity appeared to be the result of longer visits rather than lower work effort.

Finally, western physicians saw fewer patients per hour and worked fewer hours overall than physicians in other regions. In the office setting, however, they worked longer hours, although they still saw fewer patients per year.

Holding constant confounding factors, the multivariate analysis confirmed many of the descriptive findings and isolated the most important factors associated with productivity and work effort. Estimation of production functions using alternative measures of output suggest that as expected, physician hours is the most important determinant of productivity. However the estimated physician hours elasticity of output ranged from .24 to .67 depending on the measure used for output. Medical supplies, office space and non-physician aides all enhance productivity as well, although the coefficient on equipment inputs remained insignificant for all the analyses.

Although ambiguous in the descriptive analysis, the effects of physician age show a strong inverted-U shape relationship both with respect to productivity and work effort in the multivariate analyses. Female physicians see significantly fewer patients annually than male physicians, however since they are not less productive on a gross revenue basis, fewer annual visits most likely result from females providing longer, higher quality visits. Although female physicians do not work significantly fewer office hours than male physicians, they do appear to work less on a total hours basis. By contrast, having an outside income source significantly reduces office work effort, but does not reduce total work effort.

According to our estimates, physicians in group practice are more productive than solo physicians on a visit basis, regardless of group size. However group practitioners do not show significantly higher per-physician gross revenues than solo practitioners. Holding constant employment status, physicians in group practice actually show a higher work effort, at least in the office setting. As expected, employed physicians show lower work efforts than self-employed physicians.

Physicians participating in IPAs appear slightly more productive and work longer hours than non-AHP participants. However, no productivity distinction can be made between physicians particpating in HMOs or PPOs and other physicians, even holding constant confounding factors (such as region).

Population characteristics, such as per-capita income and physician availability, affect productivity differentially, depending on the measure used. Per capita income, proxying demand for higher quality, longer visits, is negatively associated with annual visits, while physician availability, capturing the degree of competition faced by the physician, is negatively related to productivity measured in gross revenues.

## 1.3 Overview of the Report

In this report we are interested in the factors influencing physician productivity and work effort. Chapter 2 identifies these factors through a literature review. Theory provides a number of hypotheses about practice, demand and personal physician characteristics influencing productivity, which are developed in Chapter 3. Chapter 4 describes the measurement of productivity along with the data sources and methods for the descriptive analysis. Simple temporal and cross-sectional descriptive analyses are presented in Chapter 5. Finally, Chapter 6 provides both the methods and results of the multivariate analyses.

## 2.0 Interpretative Literature Review

The factors on which physician productivity depends may be grouped as follows:

- Input substitution (labor or capital) for medical manpower

- Practice organization (e.g. group versus solo)

- Physician characteristics (e.g. specialty, age, sex)

This chapter summarizes and evaluates the literature on the factors affecting physician productivity. Section 2.1 treats input substitution, Section 2.2 practice organization, and Section 2.3 physician characteristics. Section 2.4 considers trends in physician productivity and Section 2.5 draws implications of the literature for forecasting physician productivity. Both conceptual issues and empirical results are discussed. Emphasis is placed on trends affecting productivity. In several instances, simple empirical evidence is adduced to augment or update the literature. The focus of the chapter is physician productivity in the office setting, not in the hospital or other settings. The effect on average productivity of the shift of physicians from patient care to non patient care settings is not considered because the BHPr model already explicitly incorporates this shift in its health care categories (Bureau of Health Professions, The Health Professions Requirements Model, Table 3). Furthermore, the effects of physician supply on productivity are not reviewed because it seems circular to base physician requirements on the effects of actual physician supply.

## 2.1 Input Substitution

If capital and labor are substituted for physician time in the production of visits, the number of visits a physician can make, or physician productivity, will increase. What are the technical possibilities for such substitution? Will physicians choose to hire physician-extending capital and labor?

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## Capital Substitution

Let us consider capital substitution possibilities first. In the typical industry much capital investment takes the form of labor-saving devices which augment the productivity of labor. Robots which substitute for assembly-line work are one example. This type of labor-saving capital investment exists in the provision of medical services also. Well-equiped examination rooms with good diagnostic equipment may reduce the time required for the average visit. In the future, much greater use may be made of the computer in diagnosis and treatment decisions (Reinhardt, 1975; Hadley, 1975).

However, the bulk of capital investment in the medical industry is not of the labor-saving variety. Rather it permits the physician to perform otherwise impossible diagnostic or therapeutic tasks (Reinhardt, 1975, pp. 106-107). Hence, increased capital inputs may be as, or more likely to increase physician requirements than reduce them. This discussion implies that in empirical studies two types of capital should be distinguished: that which substitutes for physician services and that which complements it.

Empirical evidence on the possibility of capital substitution for physician time is very scanty. Hadley (1975) reviews a number of studies which consider the application of computer technology to physician practices. These studies demonstrate the technical feasibility of substituting computers for physicians on some tasks, but do not consider the economic feasibility of substitution. Widespread application of computer technologies in a fashion which will save physicians' time has not occurred to date and does not seem likely to occur in the near future.

Reinhardt (1975) includes a measure of capital in his estimates of production functions for physician office visits. The measure is the sum of the physician's annual depreciation expenses for medical and office equipment and his annual expense for floor space. With this admittedly imperfect measure of capital, Reinhardt estimated a very low capital elasticity of output, indicating little possibility of the substitution of capital for physician time. Kimbell and Lorant (1977), using number of examination rooms as a measure of capital, found a slightly higher capital elasticity of output than Reinhardt, but it was still low. Neither study has a really adequate measure of capital which distinguishes the physician-complementing variety from the physician-substituting kind.

In sum, although the issue has not been fully studied, it does not appear likely that physician productivity will be augmented to any significant extent in the near future by substitution of capital for physician time. The technical possibilities of substitution of traditional types of capital for physicians are limited. Eventually computer-based technologies may reduce the number of required physicians, but such a development appears to be well into the future.

## Labor Substitution

Substituting other types of manpower for physicians appears to be considerably more feasible, both in its technical and economic aspects, than capital-physician substitution. Clerical personnel can relieve the physician of bookkeeping tasks. Registered nurses can perform low-skill patient care tasks. Higher-skilled tasks involving some medical judgement can be delegated to physician assistants or nurse practitioners. The physician's time can be reserved for the highest-skilled tasks which really require his expertise. This type of delegation of tasks to various categories of personnel according to the skill level required can greatly increase physician productivity and reduce physician requirements.

A number of empirical studies have considered the potential contribution of various types of physician extenders to the delivery of medical services. Most have concluded that there are possibilities for substantial substitution of physician aides for physicians. Zeckhauser and Eliastam (1974) found that a physician assistant could replace half of a full-time physician in an urban health center. Kehrer and Zaretsky (1972) estimate that a doubling of allied health personnel input would increase total patient visits per physician by 20 to 25%. Internal medicine and general practice appeared most capable of absorbing additional ancillaries. Holmes *et al*. (1976) found that a nurse clinician, physician, and nurse were able to manage 31% more patient visits in a primary care practice during a standard day than a physician and nurse. Using activity analysis Golladay, Smith, and Miller (1972) estimated that a physician assistant increases a primary care physician's productivity by 49 to 74%. Pondy (1971) reached similar conclusions. From their estimates of production functions of medical practices, Kimbell and Lorant (1972) conclude that additional aides would add significantly to the productivity of physicians. Rabin and Spector (1980) find that 92% of primary care activities could be delegated to some sort of new health practitioner.

In his influential studies, Uwe Reinhardt (1975) considers only "traditional allied health manpower" such as RN's, medical technicians, and office aides, not the newer "physician extender"-type aides. His estimates of productivity gains attributable to greater use of aides may thus be regarded as lower limits. Reinhardt concludes that if the number of aides were doubled (from about 2 per physician to about 4) weekly physician productivity would increase from 25% up to 55% depending on specialty.

The substitution of allied health manpower for physicians appears to be economically as well as technically feasible. Based on his production function estimates Reinhardt (1972, 1975) finds that the average solo practitioner could profitably employ twice as many traditional auxilaries as he currently does. Schiff, Frazer, and Walters (1969) and Yankauer et al. (1972) indicate that it is profitable to the physician to hire pediatric nurse practitioners. Scheffler and Stinson (1972) reach the same conclusion with regard to physician assistants. Golladay et al. (1973) find task delegation to be profitable to the physician.

A number of studies, then, indicate that it is both technically and economically feasible for physicians to substantially increase their productivity by employing more aides. The magnitude of the gain depends on the type of auxiliary personnel being considered and the physician's specialty. Primary care practices can potentially achieve the largest increases in productivity.

A few studies have dissented from the optimistic picture of the productivity-enhancing potential of the new health practitioners. For example, Hershey and Kropp (1979) argue that other studies have overestimated the productivity potential and economic benefit to the physician of a physician assistant. When they consider issues of operating environment and supervisory requirements ignored in previous studies, they find that only a small gain in weekly productivity will result from adding a physician assistant to a solo ambulatory practice. Furthermore, the net income gain to the physician will be small.

Even if large potential productivity gains to employing aides exist, it has been questioned whether the gains will be realized in practice. First, it is possible that physicians will convert some of the economic benefits from hiring more aides into leisure rather than income. That is, they might reduce the number of hours they work when they hire more aides (Sorkin, 1974, p. 60) so that annual productivity rises less than hourly productivity. If so, increased use of auxilaries will not reduce physician requirements as much as otherwise. Empirical estimates (e.g. Sloan, 1975) indicate a low responsiveness of hours worked to income, however, so increased use of aides should be primarily translated into more visits, not leisure.

Second, it has also been argued that employment of paramedicals will not lead to increased physican productivity, but rather an unnecessary rise in the service intensity of visits. That is, physician extenders will not be involved in bona fide task delegation, but in the production of unnecessary ancillary services at a profit to the physician. Reinhardt's (1975, pp. 217-220) review of the empirical evidence on this issue suggests that employing more aides does in fact primarily lead to more patient visits rather than greater service intensity.

Third, physicians may resist hiring new health practitioners and delegating tasks to them (Fottler, Gibson, Pinchoff, 1980; Cherkin, 1980). This may occur because of physician managerial disutility from supervising a large staff, patient distrust of physician extenders, or simple physician ignorance of the benefits of aides. The market for medical services may not be competitive enough to force physicians to practice efficiently by hiring more aides.

Finally, licensure laws which restrict the tasks ancillaries can legally perform limit the extent of task delegation. The same is true of the refusal of third-party payors to reimburse physician extenders without a physician's authorization (Abdellah, 1982). The constraints on the use of new health professionals appear to be slowly eroding over time as licensure laws are relaxed (Abdellah, 1982) and patients and physicians become more accustomed to task delegation.

The use of aides by physicians is increasing, but given Reinhardt's estimate that the number of aides could be profitably doubled, not at an especially rapid rate. Undoubtedly some of the factors discussed above have inhibited the use of ancillaries. The AMA's Socioeconomic Characteristics of

Medical Practice 1983 reports that the number of "full-time equivalent non-physician personnel per office-based physician" increased from 1.70 in 1975 to 2.10 in 1981, with the largest absolute and percentage increases in allied health professionals (.31 to .49), not nursing or secretarial staff. The ratio of employed allied health personnel (minus dental hygienists, assistants, and laboratory technicians) to professionally active physicians increased from about 1.6 in 1970 to about 2.0 in 1982 (Health Resources and Services Administration, Report to the President and Congress on the Status of Health Personnel in the U.S., May 1984, Vol. 2, Tables B-1-4 and B-8-1). The number of physician assistants has risen rapidly from 2,000 in 1970 to 6,000 in 1978 to 13,000 in 1982 (*Ibid.*, Table B-8-1).

The conclusions we can draw about the productivity potential of physician extenders are as follows. There is probably a large potential productivity gain from greater use of aides. It is probably profitable for many physicians to hire more aides. However, there are a number of factors which in practice limit the use of aides. Hence we may expect to see a continued upward trend in the use of aides, but at a moderate pace. The future productivity gains from this source will therefore also be moderate.

## 2.2 Practice Organization

The organizational forms in which physician services are delivered may have a profound impact on physician productivity. Three central aspects of organization of practice which may affect productivity can be distinguished. One is the *size* of the practice, for example, solo versus small single-specialty group, versus large multi-specialty group. The second is whether physicians (or organizations) are *prepaid* for medical services versus compensated on a fee-for-service basis. The third is whether physicians are employees and are paid a *salary* or are self-employed on a fee-for-service basis. We treat these aspects of organization in turn, then conclude by summarizing the effects of likely organizational changes on physician productivity. The effects of Health Maintenance Organizations (HMO's) are considered in this section.

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## Practice Size, Productivity, and Economies of Scale

The average number of physicians per practice is increasing. In 1975, 54.2% of physicians (excluding those employed by hospitals and government agencies) were solo practitioners compared with 16.8% in practices of five or more physicians. By 1983, the share of physicians in solo practice declined to 48.9% while the share of physicians in practices of five or more physicians increased to 22.7% (Socioeconomic Characteristics of Medical Practice, 1984, AMA, p. 15).

What are the implications for physician requirements of the trend toward group practice? If larger practice size results in increased productivity or economies of scale, future requirements will be reduced. Economies of scale may exist for several reasons. Two of the most important are that larger scale allows greater specialization and hence efficiency, and that some inputs, either machines or aides, are indivisible and require large patient loads to be fully utilized. Newhouse (1973), on the other hand, has argued that large practice size leads to diseconomies of scale because of problems of coordination and incentives.

Physician productivity and economies of scale are distinct concepts--the former refers to a rate of output per unit input of physician time while the latter measures how output changes as all inputs are increased together. Data on solo and group practices cannot simultaneously be used to study both productivity changes and economies of scale (Hadley, 1975). One must either assume that solo and group practices have the same production function and examine economies of scale or assume that they have different production functions and study productivity differences between them. Even though conceptually distinct, since productivity and economies of scale have the same implications for physician requirements we will treat them interchangeably below.

Group practices on average employ more factor services per physician than do solo practices (Reinhardt, 1975). To disentangle the effects of group practice per se, the level of other inputs--for instance aides per physician--should be controlled for. Many studies in the literature make only unadjusted comparisons. Also, many studies fail to adequately distinguish the effects of group size from mode of payment (e.g. fee-for-service, prepayment, income-sharing, salary).

Some authors who have examined the relationship between group size and productivity have found higher productivity in groups. Boan (1966) studies Canadian group and solo practices and concludes that "it appears that productivity per physician is higher in a group setting, other things being equal, than in solo practice". See Reinhardt (1975, pp. 93-96) for criticism of Boan's methodology. Yett (1967) finds definite economies of scale in the relationship between total expenses per physician and the volume of patient visits per physician per year. Reinhardt and Yett (1972) estimate production functions relating patient visits per week to practice inputs such as personnel, equipment, supplies and physician time. They find that physicians in single specialty partnerships or groups process 4% to 13% more patient visits per week than do solo practitioners, holding factor inputs constant. Few of the group practices in their data contained more than 5 members.

Other studies have found constant returns to scale or diseconomies of size. Baily (1970) studied solo and group internists in the San Francisco Bay area. He finds that the solo internists handled a larger volume of visits per month and hour than did the group internists. Yankaeur's et al.'s (1970) national survey of pediatricians indicates no relationship between size of practice and number of physician visits per unit of time. Kimbell and Lorant (1972) used AMA survey data on both single and multispecialty group practices to estimate a Cobb-Douglas production function. Their results indicate either constant or decreasing returns to scale over groups with from 3 to 100 members.

Luft (1981) offers the following synthesis of the apparently conflicting evidence on group size and productivity. He sees the small group of two to five physicians as the most productive practice arrangement. Both solo practices and larger groups are less productive so that the economist's textbook U-shaped cost curve is present. Luft's synthesis is consistent with most of the literature and is also supported by Kimbell and Lorant's (1977) study of returns to scale, and Roos' (1980) study of group size and productivity. These latter two studies both find small groups to have the highest annual productivity, with diseconomies of scale present for large groups.

Assuming the U-shaped cost curve hypothesis to be correct, as appears to be the case, what are the implications for future physician productivity? If the trend towards larger practice size were primarily assuming the form of a shift from solo to small-group practice then we would expect an increase in productivity. But the larger groups, as well as the smaller ones, are increasing their share of physicians employed at the expense of the solo practices (AMA, Socioeconomic Characteristics of Medical Practice, 1984, p. 15). If this trend continues, the net effect may be little change in productivity due to increasing average practice size. In fact, if very large multispecialty groups (25+), such as those often associated with HMO's, increase their share of physician employment most rapidly, productivity would be expected to decline.

## Prepayment and Productivity

Compared to fee-for-service reimbursement, prepayment for medical care provides incentives for efficiency in the production of health and health services (Hadley, 1975). Under fee-for-service the physician's income depends on the number of services rendered so he faces an obvious incentive to increase the output and intensity of services provided. If patients are heavily insured, little demand-side constraint to the physician's expansion of output may exist.

If prepayment is the means of reimbursement on the other hand, the fee to the physician (or his organization such as an HMO) is fixed. Thus, a financial incentive exists to eliminate unnecessary services and provide services rendered at minimum cost and perhaps lower intensity or quality. Moreover, prepaid physicians or organizations should desire to keep their enrollees as healthy as possible by dispensing preventative care and intervening early when illness strikes.

The result of the incentives for greater efficiency under prepayment should be a lower number of required physicians when that mode of financing is employed. Prepayment for comprehensive health services is the distinguishing characteristic of the so-called Health Maintenance Organizations (HMO's), either prepaid group practices (PGP) or independent practice associations (IPA's). The empirical evidence on the effects of prepayment comes largely from the experience of these organizations.

Reinhardt (1975) cites evidence that populations covered by HMO's can be served by fewer physicians per capita, although he cautions that on average HMO enrollees are younger, healthier and more urban than the averages for the U.S. population as a whole. Lower requirements may result from either demand-side factors, that is restraining utilization, or supply-side factors such as higher physician productivity. Our concern here is with prepayment's effect on physician productivity.

In his comprehensive review of the performance of HMO's, Luft (1981) concludes that annual physician productivity in PGP HMO's, measured in terms of number of visits per year, is comparable to that of average large fee-for-service group practices, which in turn is lower than that of small groups. He states:

> The data are thus consistent with the hypothesis that the unique financial incentives of HMOs have little influence on physician productivity above and beyond the effects of group size. (Luft, 1981, p. 156).

The similarity of annual productivity in large fee-for-service and prepaid groups does mask differences in its components, however. The number of patients seen per hour, hourly productivity, appears to be substantially higher in prepaid groups than in fee-for-service groups while hours worked per week or year, work effort, is significantly lower (Luft, 1981, pp. 301-303).

So although the issue has not been exhaustively studied, the general conclusion appears to be that prepayment per se does not have much effect on annual physician productivity, in spite of the different financial incentives from fee-for-service.

## Salaried Compensation and Productivity

A physician who is reimbursed by the fee-for-service method has an incentive to work longer hours and see more patients since his income depends directly on his productivity. A salaried physician's income, on the other hand, is not tied directly to his productivity so he has little economic incentive to increase his work effort or hourly productivity beyond some minimally accepted standard (although perhaps his salary next year depends on this year's work effort). Hence we would expect to see higher productivity among fee-for-service physicians than salaried ones.

Bobula (1978) compares hourly productivity and hours worked per week in 1973 for physicians reimbursed in one of three ways: fee-for-service, salary or income-sharing. The latter refers to some prearranged plan to distribute income among physicians in a group practice; this compensation method might also be expected to dilute incentives and hence lower productivity. Bobula controls for whether a physician works in a solo or group setting. With type of practice held constant in this way, Bobula finds that the weekly productivity (both hours worked per week and patients seen per hour) is lower for salaried physicians than for doctors compensated in either of the other two ways. This effect was true of general/family practitioners, internists and pediatricians, but did not hold for surgical specialties. No significant differences in weekly productivity between fee-for-service and income-sharing physicians were detected.

Sloan (1975) finds that employed physicians devote less time per year to professional activities. He questions, however, whether this is due to the effect of type of employment per se or rather is due to a self-selection effect whereby physicians who prefer shorter hours become employees rather than being self-employed. The Kaiser Foundation study (1981; cited in Haas and Crandall (1983)) also found tht salaried physicians devote fewer hours a week to medical practice and a smaller percentages of their medical practice to patient contact. In short, since the percentage of physicians who are compensated on salary is increasing (Kaiser Foundation, 1981), we may expect a decline in productivity from this source, unless it is simply due to a self-selection effect.

## Conclusions about Practice Organization and Productivity

The organization of American medicine is in transition (Starr, 1982). The traditional independent, entrepreneurial physician of the solo practice is losing ground to larger organizations, be they group practices, HMO's, hospitals, government agencies, or corporations. The percentage of physicians in solo practice declined from 54.2% in 1975 to 48.9% in 1983 (AMA, Socioeconomic Characteristics of Medical Practice, 1984). What are the implications of these changing organizational forms for physician productivity?

To the extent that more physicians work on salary in large, multispecialty group practices such as those associated with HMO's, productivity will decline. Research clearly shows negative effects on productivity of large group size and salaried compensation. AMA data reveals that the percentage of physicians practicing in groups of larger than 25 physicians increased from 4.5% in 1975 to 5.3% in 1983. Moreover, more physicians working on salary for large bureaucracies such as hospitals and associated clinics will lower productivity.

On the other hand, a shift toward small single-specialty groups will augment productivity. For example, Kimbell and Lorant (1977) conclude that the most efficient scale of practice is in the neighborhood of 7 physicians. AMA data indicates that the percent of physicians employed by small group practices is increasing. From 1975 to 1983 the percent employed in 3-4 physician groups increased from 15% to 15.7%, in 5-7 physician groups from 6.3% to 8.6%, and in 8-25 physician groups from 6.0% to 8.8%.

In sum, the net effect of the shift from solo practice to larger organizational forms is unclear since both the more productive smaller groups and the less productive larger groups are increasing their share of physicians employed. If, eventually, the larger, salary-based, corporate forms of organizaton prevail, as some have predicted (e.g. Starr, 1982), then physician productivity will ultimately decline.

## 2.3 Physician Characteristics

In this section we examine the effect of various physician characteristics on productivity. We often find it useful to decompose annual productivity into its two components of visits per time period and work effort, or time worked per year.

### Age

Since medical school enrollments and graduations increased rapidly in the late 1960's and 1970's (between 1965 and 1980 the number of graduations per year increased from 7,409 to 15,135; Starr, 1982, p. 421) the average age of physicians has been declining. If physician productivity varies by age, the changing age profile of physicians should affect productivity.

Available data indicates that annual productivity is highest for middle-aged physicians (age 36-65). Young (under 36) and old (over 65) physicians are less productive. The AMA's Socioeconomic Characteristics of Medical Practice 1984 reports that young and old physicians both have fewer office visits per week and work fewer weeks per year than middle-aged physicians. Holding other factors constant, Lorant and Kimbell (1976) find that a higher percentage of physicians in a group practice under 35 or over 55 tend to lower the volume of weekly patient visits--the effect is small, however.. The higher productivity of the middle-aged physician is presumably due to the fact that young physicians are just beginning to build up their practices while old ones place a higher value on leisure.

What are the implications of the changing age profile for average physician productivity? A full answer to this question is clearly beyond the scope of the present endeavor since it requires a careful analysis of the future age profile of physicians. Generally, if medical school graduations level off at their present rate, it would be expected that average productivity would increase in the future as the recent large cohorts of physicians entered their most-productive middle-aged years. Well into the future the age profile of physicians would stabilize.

### Sex

The percentage of physicians who are female is increasing rapidly. From 1970 to 1981, the percentage of female physicians increased from 7.7 to 12.2 percent (AMA, Socioeconomic Characteristics of Practice, 1984). The Bureau of Health Professions projects that 14% of active physicians will be female in 1985, 16.4% in 1990, and 20% in 2000.

On average, women physicians work fewer hours per year than male physicians (Mitchell, 1984; Kehrer, 1976; Bobula, 1980). Kehrer (1976) and Bobula (1980) find that women work fewer weeks per year while Mitchell (1984) finds no significant difference. All three studies find that women work fewer hours per week. Some of the lower work effort of women is due to their concentration in specialties with shorter work weeks, but even controlling for specialty a significant difference remains (Mitchell, 1984; Bobula, 1980). Freiman and Marder (1984) find that the male/female gap in hours worked per week narrowed over the decade 1970 to 1980, although not rapidly.

As distinct from work effort, there is apparently not much evidence on productivity per se, that is on the average number of visits female physicians complete. The AMA's Socioeconomic Characteristics of Medical Practice, 1984 does report that, controlling for four specialty groups, that female physicians complete from 12 to 22% fewer patient visits per week than male physicians. Women physicians who are employees make only 4.1% fewer patient visits per week, while self-employed women make 21.1% fewer visits (not controlling for specialty). Reinhardt (1981) cites evidence that women physicians see fewer patients per hour. So it appears that female physicians are characterized by lower productivity as well as work effort.

In short, female physicians have lower average annual productivity and their proportion of the physician workforce is increasing. A decline in average productivity from this source can therefore be expected. It would be easy to overestimate the anticipated decline, though. When specialty and employee versus self-employed status are controlled for, a substantial portion of the difference between women and men physicians evaporates. Also the male/female gap in hours worked is narrowing, a trend that can be expected to continue as the labor-force attachment of women strengthens.

## Specialty

Physician productivity varies by specialty. According to the National Ambulatory Medical Survey of 1975 the mean contact duration for visits to general and family practice specialists was 12.6 minutes, but 18.2 minutes for internists, and 13.1 minutes for obstetricians/gynecologists. In 1983, GP's and FP's completed 106 office visits per week on average, internists only 60 (AMA, Socioeconomic Characteristics of Medical Practice, 1984). The general pattern is that specialists spend longer with patients, so they can process fewer visits per hour than general or family practitioners.

Of course, the unadjusted numbers presented above may be misleading because specialists may see different types of patients than GP's or differ in other ways. Greenwald *et al*. (1984) studied the relationship between specialty and duration of patient encounters using *inter alia* six tracer conditions, patient's age, and presence of comorbidity to control for the health status of the patients seen. They also held constant aspects of physicians' practice organization and personal characteristics. Controlling for these factors they still found significant differences in the expenditure of time per patient among family practitioners, cardiologists, pediatricians, and internists.

So clearly a shifting distribution of physicians among specialties would affect future average physician productivity. For a long time there has been a shift from general practitioners to specialists. For example, GP's were 26.6% of all physicians in 1963, while GP's and FP's together were only 12.5% of physicians in 1981 (AMA, Physician Characteristics and Distribution in the U.S., 1982). The trend away from general practice seems to have largely spent itself, however. The percentage of physicians who are GP's and FP's declined only from 13.9% in 1975 to 12.5% in 1981. And the Bureau of Health Professions projects that GP's and FP's will comprise 12.2% of the total physician supply in 1990 (Dept. of H&HS, Report to the President and Congress on the Status of Health Personnel in the U.S., May 1984, Vol. 2, Table B-1-27). No shifts in specialty distribution dramatic enough to have a major impact on productivity through 1990 appear likely.

## Residency Training

In spite of their declining percentage of total physician supply through at least 1980, general and family practitioners will continue to provide a substantial amount of medical care. This is especially true of ambulatory care; in 1980 one in three office visits to ambulatory care physicians was to a general or family physician (Cherkin *et al.*, 1984). Any development which will substantially affect the productivity of these physicians, then, will have an important impact on future physician requirements.

Cherkin *et al.* (1984) argue that the increasing proportion of GP's/FP's with residency training is such a development. According to them, in 1980 only about one in seven FP's and GP's had completed family practice residency training, while by 1990 the proportion will be nearly 50%. Holding a large number of physician, practice, patient and environmental factors constant, they find that the weekly productivity of GP's/FP's with residency training is about 10% lower than that of non-residency-trained physicians. When the sample is restricted to physicians under age 45, the difference is about 5%. These authors present no evidence on the number of weeks worked per year by residency status.

If the number of weeks worked is invariant to residency-training status, then the annual productivity of GP's/FP's with residency training is apparently lower. The practice pattern of residency-trained GP's/FP's is more like that of internists. As noted above the move away from general practice towards specialization appears to have virtually ended. But the trend towards lower productivity in primary care through greater physician time per patient encounter may continue as more GP's/FP's receive residency training and behave more like specialists such as internists.

## Income

A change in physicians' wage rate, or compensation per unit time, may have two effects on physicians' labor supply and hence productivity. One is a substitution effect--holding income constant, if a physician's renumeration per marginal hour worked rises, he should work more. The second effect is the income effect: if a physician's wage rises, then so does his income. With a higher income a doctor may desire to substitute leisure for work and thus reduce his labor supply. So *a priori* the direction of the change in physicians' labor supply when their wage, or income, changes is indeterminant. Concern has been expressed that if physicians' incomes grow ever larger they will cut back on their work effort and hence productivity, raising future physician requirements.

What is the empirical evidence on the shape of physicians' supply curves? In a time-series analysis, Feldstein (1970) finds a backward-bending supply curve for physicians' services but is unable to precisely estimate the wage-elasticity of supply. Sloan (1975), using 1960 and 1970 Census data, finds a low degree of responsiveness of physicians' supply to wages. He concludes that the evidence to support a backward-bending supply curve is very weak. Vahovich (1977) finds a backward-bending supply curve beyond a critical wage level for some specialties. However, he estimates that the wage elasticities of hours and weeks worked are low, so that the backward-bending supply effect is not empirically large. Mitchell (1984) reports results similar to Vahovich's: some evidence of a backward-bending supply curve, but small wage elasticities of supply.

In sum, the empirical evidence concerning a backward-bending supply curve is mixed, but the literature indicates with a reasonable degree of confidence that physician work-effort responses to wage or income changes are small. Moreover, concern over ballooning physician incomes significantly reducing work effort seems misplaced at this point. Mean real physician net income before taxes actually declined from 1973 to 1983 (AMA, Socioeconomic Characteristics of Medical Practice, 1984, Table 39 deflated by the CPI). Given growing physician supply and heightened public concern over restraining medical costs, major increases in physician incomes in the future seem unlikely.

## 2.4 Trends in Physician Productivity

After having examined a number of factors which may affect physician productivity cross-sectionally and over time, we now turn to the actual time-series trends in productivity. We begin by examining trends in one of productivity's components, work effort.

### Trends in Work Effort

Freiman and Marder (1984) have studied changes in the hours worked per week by office-based physicians over the decade 1970-1980. Overall, they find a statistically significant decline in hours of about 3%, or 1.5 hours per week. This decline was fairly uniform across most physician characteristics, although female physicians increased their hours worked slightly. They also report that from 1970 to 1980 the number of weeks worked per year did not change, so that lower weekly work effort translated into lower annual work effort. However, Freiman and Marder note that office-based physicians increased the proportion of their total hours devoted to patient care. In terms of the amount of skilled medical services delivered to patients, this change largely offset the decline in work effort. The declining trend in work-effort noted by Freiman and Marder appears to have existed since at least 1965 (Owens, 1976, 1978).

### Trends in Productivity

No hard data exist to compare physician productivity in the pre-WWII era with the postwar era. However, there was probably a large increase in productivity as physicians reallocated their time from house calls to office and hospital visits and telephone consultations. In 1930, home visits comprised 45% of all outpatient visits; in 1965 they were only 4% of the total (Hadley, 1975). Since the average house call requires three times as much physician time as an office visit, the shift towards office visits resulted in substantial time savings for the physician. This source of productivity growth had been largely exhausted by the mid-1950's (Reinhardt, 1975).

Estimates of physician productivity growth from 1950 to 1970 based on physician income or expenditures on physician services average about 3% (Reinhardt, 1975). Increased reliance on auxiliary personnel probably contributed to this trend. The observed increase in per capita expenditures on physician services represents an increase in the number of services rendered per patient visit, since the number of visits did not increase over this period.

The measure of productivity we concentrate on here, annual patient visits per physician, has been constant or falling since at least 1950. Using National Center for Health Statistics (NCHS) data, Fuchs and Kramer (1972) found that the annual number of patient visits per physician declined by 0.7% per year over the period 1948-1968. Reinhardt (1975) questions the validity of the NCHS data, noting that people tend to underreport their physician visits. However, it is not clear that underreporting has worsened over time. Reinhardt also points out that hospital visits are increasing as a proportion of total physician/patient contacts and that the NCHS data does not include hospital visits. Adjusting for hospital visits would reduce Fuch/Kramer's estimated productivity decline, but probably not eliminate it.

Fuchs and Kramer attribute the higher expenditures but lower visits per capita to increased service intensity. They estimate that from 1948 to 1968 the quantity of services per patient visit rose at an annual rate of 2.8%. Of this increase, roughly 0.9% is estimated to reflect the shift from general practitioners to specialists. The remaining 1.9% appears to result from an increase in services per visit, even for general practices.

Wilson and Begun (1977), also using NCHS data, reach similar conclusions to Fuchs and Kramer for the 1959 to 1974 period. They adjust total patient contacts per physician for the increasing number of inpatient days. Their data reveals no very clear trend, but, if anything, a slight decline in patient contacts per physician. They attribute the lack of any increase in productivity to increasing specialization and higher quality of care.

Wilson and Begun's time series ends in 1974. An updating of their numbers to 1981 is possible. According to NCHS, Current Estimates from the NHIS, the total number of physician visits in 1981 was 1,038,616 thousand. Further, from NCHS, Utilization of Short-Stay Hospitals, 1981 we have that the number of days of care in 1981 at non-federal short-stay hospitals was 277, 230 thousand. Following Wilson and Begun, we assume one physician visit per inpatient day and add physician visits to inpatient days to derive the total number of physician contacts in 1981. We divide this number by the total number of non-federal patient care physicians estimated from the AMA's Physician Characteristics and Distribution in the U.S., 1982. The resulting number of total patient contacts per physician, 1981, is very comparable to Wilson and Begun's time series for 1959-1974. We find total patient contacts per physician to be 3691 in 1981. This figure is substantially lower than the numbers for 1959-1974, which cluster around 4500 with no strong trend. Apparently there was a significant downward trend in physician productivity, measured by number of visits, from 1974 to 1981. If only office visits are considered, the decline in productivity is even more marked.

The declining number of patient visits per physician can be colloborated with AMA data. Excluding physicians in the specialties of psychiatry, radiology, anesthesiology, and pathology, from 1975 to 1980, the mean number of total patient visits per week, per physician declined from 139.2 to 117.0, a drop of 16%. The standard error (s.e.) of these estimates is approximately 1.3 visits so the decline is clearly not due to sampling fluctuations. The specialties of GP/FP, internal medicine, surgery, and obstetrics/gynecological experienced statistically significant declines in total patient visits from 1975 to 1980, while pediatrics did not. Over the same period, the average number of office visits per physician per week fell from 100.8 to 88.6 (s.e. approx. 1.1). Again pediatrics is the only specialty which did not show a statistically significant decline.

From 1980 to 1982, the AMA switched from its "Periodic Survey of Physicians" to a "Socioeconomic Monitoring System"; thus estimates from 1982 and after are not fully comparable to those from 1980 and before. The estimates made with the new methodology reveal a statistically significant drop of about 5% in total patient visits per physician (excluding those specialties mentioned above) per week from 1982 to 1983. A decline of about

4% in office visits per week is registered. The mean number of visits on hospital rounds also declined by a statistically significantly 4% from 1982 to 1983. Over the period 1975 to 1983, the average number of weeks worked per year was roughly constant, so that fewer patient visits per week translated into lower annual productivity.

In short, physician productivity, measured as number of patient visits per physician per year, has not risen since at least 1950. In fact, it seems to have declined rather sharply from the mid-1970's into the early 1980's. Some of the decline in productivity, or at least its failure to rise, is surely due to the increased specialization and service-intensity of visits. Some might also be due to declining work effort, although Freiman and Marder (1984) calculate that the total number of patient care hours per week supplied per physician was fairly stable from 1970 to 1980. A third factor may be the increasing physician to population ratio coupled with a stable number of nonhospital physician visits per capita from 1960 to 1980.

## 2.5 Conclusions and Implications for Forecasting Physician Productivity

Certain factors have not been found in the literature to be major sources, or potentially major sources of changes in physician productivity. The substitution of capital for physician manpower falls in this category. Most capital investment in the medical sector is of a variety complementary to physicians' services rather than substitutable for them. The possibility of substituting traditional types of capital for physicians is limited. Eventually computer-based technologies may substitute for certain physician services, but that development appears to be well into the future.

Among the elements of practice organization, prepayment has not been found to have any major impact on physician productivity. Thus the trend towards prepayment for comprehensive health services is not expected to have any large effect on productivity. Among physician characteristics, income seems to have only a small effect on work effort and hence productivity. So unless major fluctuations in physician income (or wage rate) occur, little variation in productivity may be anticipated from this source. Physician age causes some cross-sectional variation in productivity, but it is not clear that the shifting age profile of physicians over time will be the source of important time series changes in productivity.

The only possible source of significant future gains in physician productivity appears to be the substitution of allied health manpower for physicians. Potentially large improvements, especially in primary care, are apparently achievable in this way. Whether these potential gains will be realized is another matter. Although hiring more aides appears to be profitable to physicians, numerous practical, legal, and attitudinal barriers have slowed their acceptance. The number of auxiliary personnel per physician has been increasing, however. With the trend towards group practice, cost containment, and larger organizational forms such as hospitals and corporations employing more physicians we should see a continued increase in the use of auxiliary personnel per physician. The resulting productivity gains, though, are unlikely to approach the enormous potential improvements estimated by some researchers.

On the other side of the ledger, several trends portend lower future productivity. One is the rising proportion of women doctors. At present, on average female physicians have lower annual productivity than male ones. This gap will probably narrow over time as the labor force attachment of women increases, but is likely to remain large for some time.

The second development which implies lower future productivity is the long-term trend towards more specialized, time-intensive, service-intensive, and higher quality care. The movement of doctors out of general practice into the specialties seems to have been arrested. On the other hand, within specialties the trend towards more intensive care continues. For example, the increasing proportion of general/family practitioners with residency training indicates that more and more general practitioners will practice like specialists, who are less productive. Even with intensified cost-containment pressures and a stable proportion of general practitioners, the trend towards greater service intensity should continue, albeit at a slower pace.

The array of organizational forms in the medical sector is becoming extraordinarily complex. Predicting which types will predominate is difficult (Starr, 1982). The productivity implications of many of the new kinds of practice arrangements (e.g. the rapidly growing "emergicenters" or "convenience clinics") have not been adequately studied. Nevertheless certain general conclusions about the relationship of productivity to organization emerge from the literature. One is that physicians in small group practices are most productive. Large multispecialty group practices appear to be particularly unproductive. Another is that salaried physicians are less productive than fee-for-service or income-sharing doctors.

AMA data indicates that the proportion of doctors working in both the highly productive small group practices and the less productive large group practices is rising. Without a more detailed analysis, the net effect of the trend toward a larger average practice size is therefore uncertain. Good time series data on the way in which physicians are compensated is hard to come by, but there seems to be a trend towards more salaried and employed physicians as opposed to fee-for-service compensation and self-employment. This development implies lower future productivity. As medicine becomes more bureaucratized and corporatized, and renumeration is disassociated from patients seen, productivity should fall. The precise trajectory of such change is difficult to anticipate, however.

In sum, in projecting potential future physician productivity the following four factors should be emphasized:

- The trend towards increased numbers of ancilliary personnel per physician
- The growing proportion of female physicians
- The trend towards more service and time-intensive visits
- Changing organizational forms in the medical sector. Special attention should be paid to the distribution of physicians by group size (not just the average number of physicians per practice) and the proportion of physicians who are on salary versus self-employed.

## 3.0 THEORY

Physician productivity has been found to depend on physician preferences and characteristics, production processes, and demand characteristics. The traditional five-equation model often seen in the physician-behavior literature (Reinhardt, 1975, Appendix B; Ramsey, 1980) provides the basic assumptions and analytical framework for describing the relationships among these variables for the self-employed physician. To allow for different production functions and income sources across physicians, a modified specification of the five equation model was used:

Utility: $U = U(I,L;Z)$ (3.1)

Income: $I = UY + FS \cdot VS - (w \cdot NS + r \cdot KS) + AY$ (3.2)

Production: $V = VS(HS, NS, \overline{KS}; ES) + VA(HA, \overline{NA}, \overline{KA}; EA)$ (3.3)

Time: $\bar{T} = HS + HA + L$ (3.4)

Demand: $FS = FS(VS; M)$ (3.5)

where:
$U$ = utility,
$I$ = total income,
$L$ = leisure,
$Z$ = exogenous preferences,
$UY$ = unearned income,
$FS$ = service fees in the self-employed setting,
$VS$ = services (visits) in the self-employed setting,
$w$ = price of labor inputs,
$NS$ = amount of labor inputs in self-employed setting,
$\underline{r}$ = price of non-labor inputs,
$\overline{KS}$ = fixed amount of non-labor inputs in self-employed setting,
$AY$ = income from alternative health plan participation,
$VA$ = services provided in alternative practice setting,
$V$ = total physician output,
$HS$ = physician work hours in self-employed setting,
$ES$ = exogenous production factors in self-employed setting,
$HA$ = physician work hours in alternative practice setting,
$NA$ = amount of labor inputs in alternative practice setting,
$\overline{KA}$ = fixed amount of non-labor inputs in alternative setting,
$EA$ = exogenous production factors in alternative setting,
$\bar{T}$ = fixed amount of time in period,
$L$ = physician leisure hours, and
$M$ = exogenous demand factors.

Utility (U) is assumed to increase monotonically with income (I) and leisure (L) depending on exogenous preferences (Z) such as age and sex. Females, for example, may prefer more "leisure" in order to raise a family. Physicians maximize utility subject to constraints on their ability to generate income which in turn depends on any limits on their productivity, own time inputs, and the demand for their services. Physician income (I) is the sum of unearned income (UY) and earned income, both from physicians own practice and any other alternative practice arrangement (AY) they may participate in. Unlike earned income, UY is not endogenous and thus can be thought of as simply shifting the income function. Self-employed earned income is defined as the physician's total revenues from his own practice less his total costs ($FS \cdot VS - w \cdot NS - r \cdot KS$), where FS is his visit fee; VS, services rendered (measured in visits); and NS and KS are variable labor and fixed capital inputs, respectively, with w and r their corresponding factor prices. Thus specified, self-employed income is dependent on both production in the self-employed setting and demand for physician services.

Income from alternative practice arrangements (AY) is defined as some general function of services provided in alternative settings. The exact specification of income from this source can vary from a fee-for-service type of arrangement similar to that specified for the self-employed physicians, to some kind of hourly compensation or salary, perhaps with bonuses or profit-sharing. For example, an AY for a physician participating in an IPA or PPO with a discounted fee-for-service payment arrangement might be specified as follows:

$$AY = FA \cdot VA - w \cdot NS - r \cdot \overline{KS} \qquad (3.6)$$

where FA is some fixed discounted fee charged for these patients. By contrast, AY for a physician employed in an HMO would more likely be paid on an hourly or salary basis perhaps with some type of bonus arrangement. A simplification of such payment methods can be written as:

$$AY = WA(VA) \cdot HA \qquad (3.7)$$

where WA is some imputed physician wage dependent on the number of services (VA) to be provided in the HMO. Assuming that WA depends on a fixed capitation rate and enrollment in the organization, and that services are an increasing function of enrollment, then VA should be an increasing function of WA. HA may be thought as variable for an hourly compensation arrangement and fixed (or at least bounded by some minimum amount) for a salary arrangement.

Clearly, these different compensation methods should provide both different work effort and practice incentives for physicians. Fee for-service physicians presumably have a greater incentive to see more patients in a shorter amount of time since their income is more directly related to the number of visits provided. Both fee-for-service physicians and physicians compensated on an hourly basis can be expected to have greater incentives to work longer hours because compensation is more directly tied to production than for the salaried physician. Of course, with insufficient demand, fee-for-service physicians might have a greater incentive to work fewer hours than salaried physicians who are required by contract to work a minimum number of hours.

VS is an increasing function of inputs NS and KS in addition to physician hours, $H_S$. Exogenous production factors (ES), such as group vs. solo practice, are responsible for upward or downward shifts in the function. Similary VA is an increasing function of NA, KA, and HA, although in the employed setting, both capital (KA) and labor inputs (NA) are fixed or predetermined by the employer. The time constraint in equation (3.4) defines the tradeoff between physician work and leisure hours where T represents the fixed amount of time in a given period.

Finally, equation (3.5) reflects the downward-sloping demand curve faced by the physician. Although more realistic than a competitive price-taker model, the price-setting model complicates the productivity analysis. Like the price-taker, the price-maker responds positively to price changes due to exogenous factors, M, by increasing the number of visits he provides. However, the price-maker can also increase his fee without losing all of his patients, making fees negatively related to visits. Furthermore, the underlying assumption of this downward sloping demand curve is that the physician has differentiated his product (by specialty for example) and is providing a somewhat unique visit. Unfortunately, comparisons of physician productivity as measured by visits per week or year are only meaningful if those visits are homogeneous. This problem is discussed further in Chapters 4 and 6.

OThe model assumes a two-part decision-making process in which the physician maximizes his utility in equation 3.1 subject to income, production, time and demand constraints in equations 3.2 through 3.5. Substituting equations 3.3 and 3.5 into 3.2 yields the first part of the decision-making process shown in the following income-leisure opportunity locus:

$$I = UY + FS[VS(HS,\ \overline{KS},\ NS;\ ES);M] \cdot VS[HS,\ KS,\ NS;\ ES] - (w \cdot NS + r \cdot KS)$$
$$+ AY(VA(HA,\ NA,\ \overline{KA};EA)) \qquad (3.8)$$

Keeping in mind the inverse relationship between leisure (L) and work hours (HS and HA) defined in equation 3.4, we can take the derivative of income with respect to leisure describing the slope of the income-leisure opportunity locus as follows:

$$\frac{dI}{dL} = \underset{(-)}{\frac{dFS}{dVS}} \cdot \underset{(+)}{\frac{dVS}{dHS}} \cdot \underset{(-)}{\frac{dHS}{dLS}} \cdot VS + FS \cdot \underset{(+)}{\frac{dVS}{dHS}} \cdot \underset{(-)}{\frac{dHS}{dL}} + \underset{(+)}{\frac{dAY}{dVA}} \cdot \underset{(+)}{\frac{dVA}{dHA}} \cdot \underset{(-)}{\frac{dHA}{dL}} \gtreqless 0 \qquad (3.9)$$

The overall sign of dI/dL is ambiguous since the first expression in brackets representing demand changes is positive and the remaining expressions representing production changes is negative. The shape of such an income-leisure opportunity locus can be seen graphically by curve $C_1$ in Figure 3-1. Making the usual assumptions about the utility function (e.g. more is better, non-lexigraphic preference ordering, etc.), curves $U_0$ through $U_1$ represent indifference curves for ascending levels of utility.

Clearly no physician deriving utility from both leisure and income will work more than $L_1$ hours since by increasing his leisure he could have more of both income and leisure. Thus, the portion of the curve C in which positive demand effects dominate negative production effects is irrelevant to the work effort decision.

The physician chooses the optimal consumption and leisure levels based on his marginal utility of goods and leisure. This can be demonstrated mathematically by substituting equation 3.4 into 3.6 and using the Lagrange-

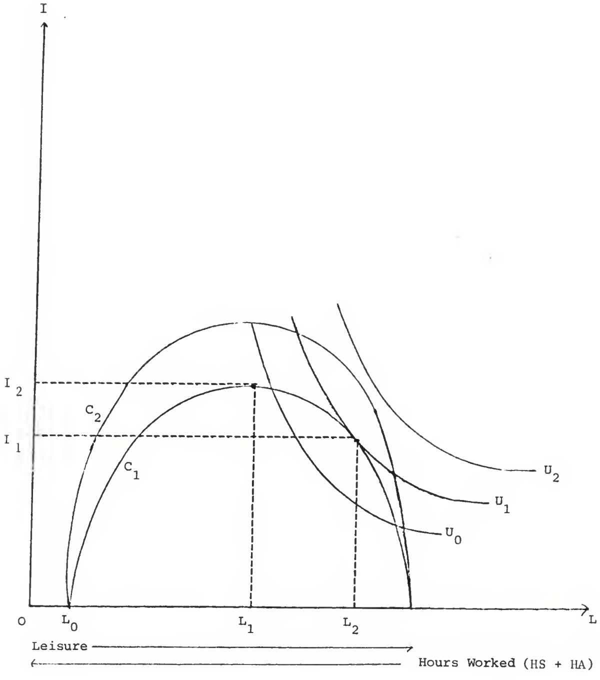

FIGURE 3-1. PHYSICIAN INCOME-LEISURE DECISION-MAKING PROCESS

multiplier method of maximizing utility (equation 3.1) subject to the income-leisure constraint:

$$\phi = U(I,\ L;\ Z) + \lambda[I-(UY + FS \cdot VS - (w \cdot NS + r \cdot KS) + AY)] \qquad (3.10)$$

The first order conditions resulting from this constrained optimization problem are as follows:

$$\frac{d\phi}{d\lambda} = I - UY - FS \cdot VS + w \cdot NS + r \cdot \overline{KS} - AY = 0 \qquad (3.11)$$

$$\frac{d\phi}{dHS} = U_{HS} - \lambda \cdot FS_{HS} \cdot VS + \lambda \cdot FS \cdot VS_{HS} = 0 \qquad (3.12)$$

$$\frac{d\phi}{dHA} = U_{HA} - \lambda \cdot AY_{HA} = 0 \qquad (3.13)$$

$$\frac{d\phi}{dI} = U_{I} + \lambda = 0 \qquad (3.14)$$

$$\frac{d\phi}{dNS} = -\lambda \cdot FS_{NS} \cdot VS - \lambda \cdot FS \cdot VS_{NS} + w \cdot \lambda + AY_{NS} = 0 \qquad (3.15)$$

Recognizing that the marginal utility of leisure ($U_L$) is simply the inverse of the marginal utility of working hours ($U_{HS} + U_{HA}$), it is clear from equation 3.12 and 3.13 that physicians will equalize the value of their marginal product ($VMP_H$) between self-employed and alternative practice settings (i.e. they will choose HS and HA such that $FS_{HS} \cdot VS + FS \cdot VS_{HS} = AY_{HA} = VMP_H$). Rearranging equations 3.12 through 3.14 it can be shown that at the optimal work effort level, the ratio of the marginal utilities of leisure and income will equal the value of the physician's marginal product:

$$\frac{U_L}{U_I} = FS_{HS} \cdot VS + FS \cdot VS_{HS} = AY_{HA} = VMP_H \qquad (3.16)$$

In Figure 3-1, this condition is only met at the tangency point of curves $U_1$ and $C_1$, corresponding to optimal leisure and income levels of $I_1$ and $L_2$. Similarly, from equation (3.15) it is clear that the physician will hire non-physician labor until the value of the marginal product of NS($VMP_N$) equals the going wage rate:

$$VMP_N = FS_{NS} \cdot VS + FS \cdot VS_{NS} = w \tag{3.17}$$

While the main focus of this study is on physician productivity, it is clear from the derived demand equations presented above that production as a function of choice variables **NS**, **HS**, **NA**, and **HA** (see eq. 3.3) can also be specified as a function of all of the exogenous variables in equations (3.1) through (3.5). Any changes in exogenous variables leading to a new optimal work effort will also change physician productivity. It is not possible, however, to ascertain the direction of change since the new combination also depends on the shape of the physician's utility function. For example, a relaxation of the goods-leisure constraint from $C_1$ to $C_2$ in Figure 3-1 will always allow a physician to increase his utility. However, whether physicians increase their utility by working less or increasing their income, or by a little of both, depends on their marginal preferences for leisure and all other goods.

Expansion of the goods-leisure constraint from $C_1$ to $C_2$ in Figure 2-1 can result from many exogenous factors. For example, if unearned income increases, the constraint will expand. Any variable which increases physician demand, such as more health insurance, or less physician competition, can relax the constraint. Personal factors such as physician training can affect productivity in two ways via the production function and through demand. Increased training can make the physician more productive; it can also increase perceived quality of his service and thereby increase his demand. Economies of scale arising from group practice can also rotate the goods-leisure constraint outwards via the production function.

Even with identical constraints, two physicians can exhibit different productivity rates based on their different preferences for goods and leisure. For example, older physicians or female physicians with many responsibilities in the home may have strong leisure preferences, appearing less productive than young or male physicians, at least on an annual if not hourly basis. By contrast physicians supporting a family might have high income preferences making them appear more productive than their childless counterparts.

Annual productivity (APROD) can be decomposed into intensity (visits per hour) and work effort components in the self-employed vs. employed sectors respectively:

$$APROD = \frac{VS\ (HS,\ NS,\ \overline{KS};\ ES)}{HS} \cdot HS + \frac{VA\ (HA,\ NA,\ \overline{KA};\ EA)}{HA} \cdot HA \qquad (3.18)$$

Given an output elasticity of 1, the intensity components would be primarily a function of production characteristics since all of the exogenous utility factors affect these visits via HS or HA. Assuming that physician marginal productivity varies with the level of output, it is unlikely that doubling physician inputs would double the number of services rendered. However, standardizing visits by hours should purge much of the labor supply effects on productivity, whereas the work effort components, HA and HS, should be particularly sensitive to labor supply decision variables. Analyzing these components separately can help determine which variables affect productivity predominantly through the production process versus work effort decisions.

# 4.0 DATA AND METHODS

## 4.1 Data Sources

The primary database for these analyses are the 1975, 1978 and 1984-85 physician surveys conducted by the National Opinion Research Center (NORC) for the Health Care Financing Administration (HCFA). Physicians in all these surveys were asked (usually by telephone) to answer a wide range of questions about their practices as well as some biographical questions. While all three surveys were designed to be nationally representative and used a similar questionnaire, they are not completely comparable. Fortunately, the questions regarding physician productivity (i.e. the number of hours worked and patients seen per week in various settings) are highly comparable, allowing us to conduct some simple trend analysis of physician productivity over time. However, differences among the surveys (regarding the number and type of specialists interviewed) limit these analyses and preclude pooled, cross-section, time-series analysis. As a result, only the most recent 1984-85 survey was used for the cross-sectional analyses.

### 4.1.1 Temporal Comparability of the Physician Surveys

While all three surveys interviewed only those physicians working at least 20 hours a week, the earlier surveys excluded some physicians based on specialty, employment status, and practice size. The first survey is the least extensive of the three. Only 5 specialties were surveyed, compared to 15 in 1978 and all specialties in 1984-85. In both 1975 and 1978, only office-based, self-employed physicians were surveyed, while the 1984-85 survey included hospital-based and employed physicians. Finally, physicians in large practices were excluded from the 1975 and 1978 surveys. Consequently we subsetted to self-employed physicians in groups of no more than 10 to make temporal comparisons of physician productivity. In addition, all productivity trend analysis was conducted on a specialty-specific basis using weights to adjust for nonresponse bias in each survey year (see Section 4.1.3).

The wording of the physician productivity questions was identical in all three survey periods for the data on weekly visits and hours in the office, hospital, and nursing home settings. However, the questions on weeks worked per year and other medical hours changed very slightly from survey to survey. While the former change could potentially affect annual productivity measures, the bias is not likely to be large. Also, since the sample sizes for some of the more obscure settings were quite small at the specialty level, productivity trend analysis was limited to the more common office and hospital settings.

### 4.1.2 Description of Data for the Cross-sectional Analysis

The HCFA-NORC 1984-5 Physician Survey is especially well-suited for cross-sectional analysis of physician productivity. Unlike the earlier HCFA-NORC surveys, it includes data on a much wider range of specialties and practice organizations. In addition to including physicians in large practices and employed physicians, the survey provides data on physicians' participation in alternative health plans (AHPs), and physician race. Altogether, 4,729 physicians were interviewed, although for most of our analysis we work with a smaller subset since not all specialties were asked questions about the number of hours they worked and patients they had seen. For example, radiologists, anesthesiologist, and pathologists (RAPs) are excluded from our analysis. Also, many physicians did not answer some of the relevant questions about practice costs and organization.

Like the earlier surveys, financial data on the physicians' practice (e.g. equipment costs and service fees) were provided, although they refer to the 1983 calendar year, while the productivity data refer to the 1984-85 years. Biographical data on the physician (e.g. sex, age, marital status) were also available either from the survey or from the American Medical Association's Masterfile. Finally, demand characteristics describing physician scarcity and the wealth and density of the population were obtained from the Area Resource File (ARF) and are consequently only current through 1980 or 1982, depending on the variable.

While the extensive scope of the 1984-85 survey allows us to examine a wide range of physician productivity effects, there are a few limitations. First, restricting the analysis to one time period not only precludes temporal productivity analysis, it limits specialty-specific analyses that yield small sample sizes. Specialties must be combined for productivity analysis, creating the need for specialty adjustments, which may not totally eliminate specialty effects. Second, while data regarding the employment status of physicians exist, it is not possible to distinguish between salaried and fee-for-service physicians. This shortcoming precludes testing hypotheses regarding the impact of reimbursement methods on physician productivity. Finally, the exclusion of physicians working less than 20 hours per week narrows the range of observed productivity by putting a floor on work effort.

### 4.1.3 Sample Design and Weighting

The sampling frame for the HCFA-NORC Physician Survey was the Master Physician File maintained by the American Medical Association (AMA). A single-stage, stratified element level, random sampling design was used by NORC. The 136 strata resulted from the interaction of three basic dimensions: specialty groups (17), Census regions (4), and MSA/non-MSA (2). Some small specialties (e.g., cardiology, orthopedic surgery, opthalmology) were over-sampled to achieve a minimum of 200 sample cases.

Of 8,952 contacted cases, 2,100 (23.5 percent) were found to be ineligible (see Table 4-1). A case was considered ineligible if it met one or more of the following criteria:

- did not provide patient care at least 20 hours per week at the time of interview;
- did not, in any part of 1983, engage in patient care for at least 20 hours per week;
- was a resident or research fellow at a medical school;
- was employed by the Federal Government;
- was employed by state/local government in a non-patient care capacity;
- lived outside the 50 United States or the District of Columbia;
- was a full-time faculty member, unless providing at least 20 hours of patient care per week; or
- the whereabouts could not be located.

TABLE 4-1

## RESPONSE TO 1984-1985 PHYSICIANS' PRACTICE COSTS AND INCOME SURVEY BY SPECIALTY, CENSUS REGION, AND DEGREE OF URBANIZATION

| Dimension | Number of cases with eligibility determined* | Ineligible Cases | | Completed Cases | |
|---|---|---|---|---|---|
| | | Number | Percent of cases ineligible** | Number | Weighted Completion Rate*** |
| Total | 8,947 | 2,100 | 23.5% | 4,729 | 67.7% |
| **Specialty** | | | | | |
| General Practice | 663 | 192 | 29.0 | 315 | 64.8 |
| Family Practice | 574 | 91 | 15.9 | 351 | 72.2 |
| Internal Medicine | 948 | 230 | 24.3 | 455 | 62.5 |
| Cardiology | 379 | 72 | 19.0 | 167 | 53.1 |
| Pediatrics | 597 | 164 | 27.5 | 300 | 68.0 |
| Other Medical | 517 | 92 | 17.8 | 284 | 65.9 |
| General Surgery | 484 | 106 | 21.9 | 271 | 70.8 |
| Orthopedic Surgery | 308 | 44 | 14.3 | 154 | 56.2 |
| Ophthalmology | 315 | 58 | 18.4 | 160 | 61.1 |
| Urology | 340 | 61 | 17.9 | 187 | 65.9 |
| Obstetrics/Gynecology | 490 | 81 | 16.5 | 281 | 66.1 |
| Other Surgical | 345 | 69 | 20.0 | 188 | 66.8 |
| Psychiatry | 573 | 156 | 27.2 | 321 | 74.4 |
| Anesthesiology | 569 | 146 | 25.7 | 330 | 76.7 |
| Pathology | 618 | 191 | 30.9 | 321 | 74.9 |
| Radiology | 594 | 144 | 24.2 | 327 | 72.1 |
| All Other Specialties | 633 | 203 | 32.1 | 317 | 70.9 |
| **Census Region** | | | | | |
| North East | 2,255 | 626 | 27.8 | 1,139 | 69.9 |
| North Central | 2,002 | 465 | 23.2 | 1,090 | 70.9 |
| South | 2,719 | 575 | 21.1 | 1,480 | 69.0 |
| West | 1,971 | 434 | 22.0 | 1,020 | 66.4 |
| **Degree of Urbanization** | | | | | |
| Metropolitan Statistical Areas | 7,556 | 1,872 | 24.8 | 3,873 | 66.8 |
| Outside Metropolitan Statistical Areas | 1,391 | 228 | 16.4 | 856 | 72.0 |

*A total of 9,130 cases were fielded.

**Percent of cases ineligible = number of ineligible cases/number of cases with eligibility determined.

***These rates reflect an adjustment for cases of indeterminate eligibility (data not shown). Cases with indeterminate eligibility were assigned to the "eligible" or "ineligible" categories, based on the proportions for the cases for which eligibility was determined.

Among eligible cases, a weighted completion rate of 67.7 percent was obtained. There was a wide range in completion rates by specialty, with a high of 77 percent among anesthesiologists and a low of 53 percent among cardiologists (see Table 4-1).

All of the analyses in this report use the data weights supplied by NORC. The reasons for weighting are twofold. First, the data weights adjust for the differential over or under-sampling of specialty groups. The probability of selection is disproportionate across the 136 strata, even though within each strata all physicians have the same probability of selection. Hence, in any analysis combining specialties, it is necessary to use the weights. Second, the weights account for nonresponse within each stratum. Thus, even in specialty-specific analysis it is necessary to weight estimates, although here it is appropriate to normalize the weights to the individual specialty, not the entire sample.

The weight for each stratum is derived as follows:

$$W = (N * (C/A))/D$$

where W = sample weight
N = sampling frame size (i.e., size of the target population)
A = contacted cases for which eligibility was determined
C = cases eligible for interview
D = completed cases.

The sampling frame size (N) corresponds to the number of physicians in the population, as measured by the AMA Master Physician File. (The frame size was calculated for each of the 136 strata.) The number of cases eligible for interview (C) is a subset of the number of contacted cases for which eligibility was determined (A). The ratio of C:A is the percent of contacted cases that were eligible for the survey (based on the eligibility criteria discussed above). The denominator (D) represents the number of completed cases in each stratum. As an example:

Let $N = 300;\ A = 30;\ C = 27;\ D = 18.$
Thus, $W = (300*(27/30))/18 = 15.$

We then normalized the weights either to the entire sample, or to the specialty, depending on the level of analysis.

## 4.2 Methods

### 4.2.1 Measuring productivity

### Visits as an Output Measure

Physician productivity is a rate of output per unit of physician time input--hours, weeks, or years. Ideally, physician output should be measured as the increment to health that physician care provides. However, changes in health due to physician care are extremely difficult and expensive to measure, and they do not exist in the HCFA-NORC data set. Therefore, we have followed the usual practice of measuring physician output by the number of patient visits per time period. The visits a physician completes should be at least roughly proportional to his output of medical care.

Using visits as an output measure does ignore variations in the content of visits, which is likely to vary considerably, especially among specialties. As described below, we adjust for specialty differences in visit length in our aggregative analyses. However, intra-specialty differences in visit content remain. Some physicians may falsely appear to be unproductive using our visit output measures because their visits have greater content than other physicians.

An alternative to visits is to use patient billings or physician income as an output measure. Under certain conditions (no insurance, a competitive output market, etc.), using individual physician price weights to aggregate visits into income results in a good measure of the value of a physician's output, including the content of his visits. However, the price distortions in the medical sector due to insurance, regulation, consumer ignorance, and imperfect competition among physicians make medical practice income a dubious measure of physician output. Moreover the NORC data on physician visits is substantially more detailed and accurate than the income data. In short, patient visits give the best representation of physicians' patient-care activities and are used as our output measure.

## Aggregate Ouput Indexes

In the survey, weekly numbers of patient visits are reported in three different settings: office, hospital, and extended-care facilities. Within the hospital setting, patient encounters are comprised of the number of inpatient visits by physicians on their rounds (inpatient setting) the number of emergency room and OPD visits (OPD setting), and the number of operations (surgery setting) for a total of five "settings" in all. Some of our analysis is disaggregate and examines visits as output measures in each of the five settings or in the two most common settings, office and inpatient. For additional descriptive and multivariate analysis it is useful to have a single, summary measure of physician output. A unidimensional output measure requires an aggregation across the five visit settings.

Two basic methods of developing aggregation weights are available: a time-based approach and a value-based approach. The time-based approach assumes that physician output is proportional to time input. We measure time input, however, not as an individual physician's time, but as the average value for a physician's specialty in a given setting. The assumption here is that visit length differences across settings and specialties are indicative of real output differences while intra-specialty and setting variation in visit length is not. Thus, the output measure does not penalize psychiatrists for their long average visit lenth, but psychiatrists who have longer than average visits for their specialty are not credited with additional output.

The time-based output index was created as follows. For each specialty and each setting the mean value of hours per visit was computed. These visit weights are listed in Table 4-2. They show, for instance, that GPs' office and hospital visits are weighted equally, while operations are weighted five times as heavily as office visits. We created separate weights for GP/FPs, medical specialists, and surgical specialists, and for selected specialties within these categories. In addition, psychiatrists and emergency medicine physicians were included in the analysis. RAP's and "other specialties" (except emergency medicine) were excluded. After creating the weights by specialty, each physician's visits in each setting were multiplied by his specialty's weight for the appropriate setting and summed:

TABLE 4-2

TIME-BASED VISIT AGGREGATION WEIGHTS
(Mean hours per visit by specialty in five settings)

| SPECIALTY | OFF | HSP | ER/OPD | OPER | ECF |
|---|---|---|---|---|---|
| GP/FP | .31 | .32 | .47 | 1.56 | .26 |
| GP | .31 | .31 | .37 | 1.56 | .28 |
| FP | .32 | .33 | .51 | 1.56 | .25 |
| Medical | .38 | .36 | .51 | 1.20 | .33 |
| Int. | .43 | .34 | .60 | 1.15 | .33 |
| Card. | .50 | .39 | .77 | 1.67 | .48 |
| Ped. | .31 | .38 | .50 | 1.34 | .21 |
| Surgical | .32 | .25 | .64 | 1.91 | .40 |
| GS | .36 | .27 | .72 | 2.00 | .31 |
| Ortho. | .30 | .22 | .61 | 1.83 | .38 |
| Optha. | .31 | .38 | .60 | 1.10 | .63 |
| Urol. | .37 | .25 | .59 | 1.68 | .54 |
| Ob/Gyn | .32 | .25 | .52 | 2.28 | 1.00 |
| Psych. | .87 | .48 | .74 | * | .58 |
| Emer. Med. | .31 | .29 | .35 | 1.46 | .14 |

* No psychiatrists performed operations.

$$Q_{ij} = \sum_{k=1}^{5} W_{jk} \cdot V_{ijk} \qquad (4.1)$$

where

$Q_{ij}$ = the output of the $i^{th}$ physician in the $j^{th}$ specialty,

$W_{jk}$ = the mean hours per visit for the $j^{th}$ specialty in the $K^{th}$ setting,

$V_{ijk}$ = the $i^{th}$ physician's number of visits in the $k^{th}$ setting.

The resulting hours-based output index has several properties worth noting. First, total output averaged by specialty equals the average total number of medical hours that specialty worked. As a corollary, average output per (medical) hour equals one for each specialty. Thus, the index eliminates differences in average intensity (hourly productivity) among specialties. Differences in average total productivity (output per week or year) across specialties remain due to specialty work effort differences. Although the main purpose of the output index is to aggregate across settings, it may also be used to aggregate specialties because mean specialty differences in intensity are adjusted for.

A second output index was developed using a value-based approach. The basic assumption behind this approach is that price weights can be developed which reflect the relative values of different kinds of output and thus can be used to aggregate them. Visit weights developed for the value-based aggregation are given in Table 4-3. In creating the value-based index we generally followed the methodology of Pauly (1981), who was working with the 1976 HCFA-NORC Physician Practice and Costs Survey. Office visits are used as a base and are assigned a weight of one. The hospital visit weight for each specialty is given by the ratio of the specialty mean hospital visit fee, as estimated from the data set, to the specialty mean office visit fee. There are no fee data in the NORC data set on emergency room/outpatient department (ER/OPD) visits or on extended care facility (ECF) visits. Pauly arbitrarily assigns these visits weights of one and two, respectively. Instead of doing this, we took the ratio of the mean hours per visit in those two settings to the mean hours per office visit for each specialty (see Table 4-2) to derive weights. Hence, the relative weight assigned to ER/OPD and to ECF visits as compared to office visits is the same for both our time-based index and our value-based index.

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TABLE 4-3

VALUE-BASED VISIT AGGREGATION WEIGHTS

| SPECIALTY | OFF | HSP | ER/OPD | OPER | ECF |
|---|---|---|---|---|---|
| GP/FP | 1 | 1.13 | 1.52 | 33.4 | .84 |
| GP | 1 | 1.08 | 1.19 | 33.4 | .90 |
| FP | 1 | 1.15 | 1.59 | 33.4 | .78 |
| Medical | 1 | 1.10 | 1.34 | 31.2 | .87 |
| Int. | 1 | 1.07 | 1.40 | 30.2 | .77 |
| Card. | 1 | 1.03 | 1.54 | 30.2 | .96 |
| Ped. | 1 | 1.16 | 1.61 | 33.4 | .68 |
| Surgical | 1 | .69 | 2.00 | 30.5 | 1.25 |
| GS | 1 | .74 | 2.00 | 30.2 | .86 |
| Ortho. | 1 | .68 | 2.03 | 30.2 | 1.27 |
| Optha. | 1 | .72 | 1.94 | 29.2 | 2.03 |
| Urol. | 1 | .84 | 1.59 | 27.7 | 1.46 |
| Ob/Gyn | 1 | .60 | 1.63 | 33.4 | 3.13 |
| Psych. | 1 | .70 | .85 | – | .67 |
| Emer. Med. | 1 | .34 | 1.13 | 30.2 | .45 |

See text for explanation.

The weight for operations was developed as follows. For many specialties, the HCFA-NORC data give a current usual fee for one or more surgical procedures. A mean specialty fee per CRV unit was created by dividing the mean fee for the surgical procedure by the number of California Relative Value (CRV) Scale units in the procedure (when fees for several procedures are available in the data, a frequency-weighted average is used). For example, general surgeons' mean fee for an inguinal herniorraphy was divided by the number of CRV units for the procedure. The SOSSUS study (1975) gives estimates of the median number of CRV units per operation for most surgical specialties. Multiplying the mean number of CRV units per operation by fee per CRV unit yields an estimate of the fee per "average operation". Finally, dividing the fee per operation by the office visit fee gives an office visit equivalent per operation.

For non-surgical specialties, insufficient data exists to calculate an independent weight for operations. For GP's, FP's, and pediatricians, the weight for obstetricians/gynecologists was used. For internists, cardiologists, and emergency medicine specialists, the weight for general surgeons was used. For the overall categories "medical" and "surgical", a weighted average of the weights for the subspecialties listed in Table 4-3 was used. While this approximation is obviously not ideal, these specialties perform few operations relative to office and hospital visits (see Table 5-4), so the exact weight used for operations has little effect on their calculated output. After creating the weights, a value-based output index was created for each physician by multiplying his number of visits in each setting by his specialty's weight for that setting and then summing across settings.

## Validation of Output Indexes

Table 4-4 displays correlations between the time and value-based physician output indexes and other measures of physician output. The two indexes themselves are positively correlated, but not extremely so (a correlation coefficient of .69). Comparing Tables 4-2 and 4-3, the major difference between the two indexes is clearly the much higher relative weight the value based index places on operations. The time-based index weights operations roughly five times as highly as office visits, while the value-based index weights them about 30 times as heavily. Hence, physicians

TABLE 4-4

CORRELATIONS OF PHYSICIAN OUTPUT INDEXES WITH OTHER MEASURES OF PHYSICIAN OUTPUT

| | Time-Based Index | Value-Based Index |
|---|---|---|
| Time-based index | - | .69 |
| Value-based index | .69 | - |
| Gross income | .06 | .07 |
| Net Income | .22 | .32 |
| Total visits | .95 | .64 |
| Medical hours | .49 | .42 |

who perform many operations (e.g. surgeons) appear very productive relative to those who spend most of their time in other settings when output is measured by the value-based index.

The time-based index is very highly correlated with a simple, unweighted sum of visits across settings (total visits). The value-based index is considerably less correlated with total visits, again probably due to the extremely high weight placed on operations. Neither index is strongly correlated with gross income, but the value-based index is more strongly related to net physician income. This is expected since it is based on physician fees. Both output indexes are moderately positive related to medical hours worked.

Neither the time nor the value-based index is a perfect aggregation. The time-based index is limited because physician time is really an input to the production of medical care or health, not an output. The value-based index is limited by the difficulty of obtaining appropriate, market price weights for aggregation because of the price distortions in the medical sector. Of the two indexes, we prefer the time-based index because it is based more closely on the data and is not subject to arbitary pricing distortions. The value-based index seems to place an excessively large weight on operations. While not ideal, the time-based index provides a reasonable measure of total physician patient-care output. As Table 4-4 shows, it is closely related to an unweighted sum of visits across settings. We use the time-based index as one of the primary physician output measures in the descriptive work. Because we question the inordinately high weight it places on operations, we do not use the value-based index in our empirical work.

## Components of Productivity

In this report, both total productivity and its components are studied. Total productivity is defined as "visits" per year, (V/Y). Visits refers to some measure of physician output, for example, an output index or office or hospital visits. Visits per year can be decomposed as follows:

$$V/Y=(V/H)\cdot(H/W)\cdot(W/Y)$$

or more succinctly:

$$V/Y=(V/H)\cdot(H/Y)$$

where H is physician hours. The variable V/H represents an intensity measure, while hours per week (H/W) and weeks per year (W/Y) are two components of annual work effort (H/Y). To allow for alternative work styles (i.e., long weeks offset by long vacations), we generally measured output and work effort on a yearly basis. For some descriptive tables, however, we decomposed productivity on a weekly basis for greater ease of interpretation.

### 4.2.2 Temporal and Cross-sectional Descriptive Analysis

To predict changes in future physician requirements it would be useful to know what factors affect productivity changes over time. Ideally, pooled cross-section, time-series analysis would be used to answer this question. Unfortunately, the limitations noted above preclude this type of analysis. However, simple descriptive trend analysis of productivity measures can be conducted with the data at hand, while cross-sectional data from the 1984-85 HCFA-NORC physician survey can identify the major factors affecting physician productivity.

To examine changes in physician productivity over time, we calculated average annual percent changes in mean intensity, work effort and annual productivity between the 1975-84 and 1978-84 time periods. These productivity changes were examined in both office and hospital settings at the specialty level to maintain comparability between the surveys. Two-sample "T" tests were used to identify statistically significant changes over time.

Cross-sectional analysis of physician productivity included both an examination by specialty of work effort, distribution of time, and productivity for each patient-care setting and comparison of high vs. low productivity physicians by various practice, physician, and area characteristics. To compare high and low productivity physicians, we created high, average, and low productivity groups based on annual productivity (V/Y), work effort (H/Y) and intensity measures (V/H). Groupings were created both for productivity in all settings and for the office setting alone. To combine settings, visits were weighted and summed to create the time based output index described in Section 4.2.1. Specialties were combined for the multi-setting analysis, although for part of the office-setting analysis, six of the largest specialties were also shown separately.

Whenever specialties were combined, low, average, and high productivity groups were created on a specialty basis so that the groups were not dominated by a particular specialty. This adjustment was necessary for the weighted, multi-setting analysis as well, to adjust for work effort differences among specialties.

After analyzing productivity differences by setting and by specialty, we produced means of other physician and practice characteristics (e.g., age) by productivity group. These variables proxy the area, practice, and personal characterisitics hypothesized to influence physician productivity. Three tabulations were made: (1) high vs. low multi-setting groups for combined specialties; (2) high vs. low office-setting groups for combined specialties; and (3) high vs. low office setting groups for six individual specialties.

Practice variables included equipment costs, medical supplies, office space, number of aides per physician, practice organization, AHP participation, and office fees. Equipment costs were defined as the sum of rental and depreciation expenses for medical equipment per physician in 1983. Medical supplies is the annual cost per physician of items such as drugs, biologicals and X-ray films. Office space was defined as rental or depreciation cost for office space per physician, deflated by the county median gross rent. The latter variable was obtained from the Area Resource File. In analyzing aides per physician we differentiated administrative aides (e.g., secretaries, office managers) from medical aides, and nurses/technicians from nurse practitioners and physicians' assistants. Fees were adjusted for regional cost-of-living differences to make them comparable across productivity quartiles. AHP participants include both self-employed or employed physicians (excluding hospital employees) participating in IPAs, PPOs, or HMOs. Variables on personal physician characteristics include information on the physicians's training, family status, unearned income, age, race, and sex. Finally, demand characteristics faced by the physician are measured by the scarcity of physicians in the area (physicians per capita), the degree of urbanization, the proportion of the population which is poor, per capita income, and hospital beds per capita.

## 5.0 DESCRIPTIVE ANALYSIS

### 5.1 Trends in Physician Productivity Over Time

Table 5-1 presents average annual percent changes in three productivity measures between 1975 and 1984 in the office and hospital settings. Annual productivity (V/Y) has declined significantly in each of five major specialties. The largest decrease in office visits per year was 3.9 percent annually for general and family practitioners (GPs and FPs) while internists showed the smallest decrease (1.6 percent annually) over this period. These changes correspond to decreases of about 35 and 14 percent, respectively, over the entire period. Decreased annual productivity stems predominately from decreases in patients seen per hour (visit intensity). The downward trends were statistically significant for all five specialties shown, at least at the 90 percent confidence interval. By contrast, none of the office hour decreases were significant and OBGs actually increased their office work effort 1.1 percent annually.

Annual productivity also declined significantly in the hospital setting for all five specialties. In sharp contrast to the office setting, however, this decline is due to decreased hours spent in the hospital rather than decreased visit intensity. Increases in the amount of time spent on administrative activities across all specialties (not shown) probably explains the small decrease in office work effort since much of this activity may occur in the office setting.

Annual productivity changes between 1978 and 1984 are similar to those between 1975 and 1984 (see Table 5-2). Again, GPs and FPs were among those physicians with the largest annual decreases and internists were among the smallest. While all of the specialists in Table 5-2 (except opthalmologists) showed decreases in annual office productivity, they were only significant for GPs and FPs, obstetricians-gynecologists (OBGs), general surgeons and cardiologists. Again, annual productivity decreases in the office stemmed predominately from decreases in intensity rather than work effort.

Most of the specialties showing significant productivity declines in the office (e.g., GPs and FPs, OBGs, cardiologists and general surgeons) also show significant declines in the hospital setting. While their office productivity did not decline, opthalmologists, urologists and orthopedic

TABLE 5-1

AVERAGE ANNUAL PERCENT CHANGE IN PHYSICIAN PRODUCTIVITY BETWEEN 1975 AND 1984 BY SPECIALTY

| | OFFICE SETTING | | | HOSPITAL SETTING* | | |
|---|---|---|---|---|---|---|
| SPECIALTY | Annual Productivity | Intensity | Work Effort | Annual Productivity | Intensity | Work Effort |
| GPs/FPs | -3.9%[a] | -3.5%[a] | -0.3% | -3.2%[a] | 1.0% | -2.9%[a] |
| Internists | -1.6[a] | -1.6[a] | -0.2 | -2.4[a] | -1.1 | -1.2[b] |
| Pediatricians | -2.6[a] | -2.7[a] | -0.3 | -4.0[a] | -1.4 | -2.6[a] |
| OBGs | -2.1[a] | -3.1[a] | 1.1[a] | -5.3[a] | 0.5 | -2.9[a] |
| General Surgeons | -3.4[a] | -1.3[c] | -0.9 | -4.8[a] | 0.5 | -3.3[a] |

* Productivity measures for the hospital setting include inpatient care only (i.e. surgery and outpatient care is excluded).

[a] Significant at the 99% confidence interval
[b] Significant at the 95% confidence interval
[c] Significant at the 90% confidence interval

Sources: HCFA-NORC 1975 and 1984-85 Physician Surveys.

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TABLE 5-2

AVERAGE ANNUAL PERCENT CHANGE IN PHYSICIAN PRODUCTIVITY BETWEEN 1978 AND 1984 BY SPECIALTY

| SPECIALTY | OFFICE SETTING<br>Annual Productivity | OFFICE SETTING<br>Intensity | OFFICE SETTING<br>Work Effort | HOSPITAL SETTING*<br>Annual Productivity | HOSPITAL SETTING*<br>Intensity | HOSPITAL SETTING*<br>Work Effort |
|---|---|---|---|---|---|---|
| GPs/FPs | -3.0%[a] | -3.3%[a] | 0.3% | -4.9%[a] | -4.0%[a] | -1.2% |
| Internists | -0.3 | -0.5 | -0.1 | -1.6 | -1.7 | -0.6 |
| Pediatricians | -1.3 | -1.0 | -0.8[c] | -0.8 | -3.2 | 0.8 |
| OBGs | -1.9[a] | -4.0[a] | 0.9 | -3.6[b] | 0.3 | -2.4[c] |
| General Surgeons | -4.4[a] | -2.8[b] | -1.2 | -5.9[a] | -4.6[b] | -0.1 |
| Psychiatrists | -0.1 | 0.0 | -0.4 | 0.5 | 0.3 | 0.4 |
| Opthalmologists | 0.2 | 0.6 | -0.2 | -7.8[a] | -4.3 | -5.7[a] |
| Cardiologists | -4.0[b] | -2.5 | -1.6 | -3.0 | -6.2[a] | 4.3[a] |
| Urologists/ Orthopedic Surgeons | -1.1 | -3.8[a] | 0.9 | -4.8[a] | -5.0[a] | -1.8[c] |

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* Productivity measures for the hospital setting include inpatient care only (i.e. surgery and outpatient care is excluded).

[a] Significant at the 99% confidence interval
[b] Significant at the 95% confidence interval
[c] Significant at the 90% confidence interval

Sources: HCFA-NORC 1978 and 1984-84 Physician Surveys.

surgeons also show a statistically significant annual decline of 7.8 percent in hospital visits per year. This result suggests that perhaps some hospital visits are being transferred to the office setting in these specialties.

Between 1978 and 1984, the annual productivity decreases in the hospital setting stemmed both from intensity and work effort declines. Annual productivity decreases for GPs, FPs, general surgeons, and cardiologists were mainly (or solely) due to intensity decreases in the hospital setting, while decreases for OBGs and opthalmologists stemmed primarily from work effort declines. A few specialties actually showed increased work effort in the hospital, and for cardiologists the 4.3 percent increase was significant.

Overall, physician productivity appears to have declined over the last decade, primarily because of decreased intensity rather than decreased work effort. These results suggest that physician demand has grown more slowly than physician supply over the past decade, and that physicians are spending more time with patients and on non-patient care activities. To be sure, our comparisons are limited to physicians in groups of 10 or less because of data comparability problems (see Section 4.1.1). In 1983, a larger proportion of physicians were working in large groups with high office visit intensity (see Section 5.3) than in the 1970's. Thus, if the analysis had considered all group sizes, we might have found a smaller decrease in intensity (but perhaps a greater decrease in work effort).

## 5.2 Work Effort, Distribution of Time, and Productivity by Specialty and Setting

Table 5-3 shows mean work effort and the distribution of physician time between medical and administrative activites by specialty for 1984. In addition, it gives the average distribution of medical time across six settings -- office (Off), hospital round (Hsp), emergency room/outpatient department (Er/Opd), operation (Oper), extended-care-facilities (ECF), and other medical (Other). The final column is mean patient care hours per week, which is defined as medical time excluding "Other Medical". Other medical time primarily includes such non-patient-care activites as attending conferences and reading journals.

TABLE 5-3

WORK EFFORT AND DISTRIBUTION OF TIME BY SPECIALTY, 1984-85

| Care | | WORK EFFORT | | TIME DISTRIBUTION | | DISTRIBUTION OF MEDICAL TIME | | | | | | Pat. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specialty | N | Hrs/Wk | Wks/Yr | Adminis. | Medical | Off | Hsp | Er/Opd | Oper | ECF | Other | Hrs/Wk |
| GP/FP | 699 | 56.9 | 47.7 | 10.5% | 89.5% | 68.9% | 13.5% | 6.8% | 3.1% | 3.0% | 4.8% | 48.7 |
| GP | 233 | 53.8 | 48.3 | 10.7 | 89.3 | 71.1 | 12.6 | 5.4 | 2.9 | 3.1 | 4.9 | 45.4 |
| FP | 466 | 58.5 | 47.3 | 10.5 | 89.5 | 67.9 | 13.8 | 7.4 | 3.2 | 2.9 | 4.8 | 50.2 |
| Medical | 1201 | 57.8 | 47.5 | 10.1 | 89.9 | 57.0 | 23.6 | 7.9 | 2.2 | 1.7 | 7.5 | 48.1 |
| Int. | 472 | 59.0 | 47.5 | 10.9 | 89.1 | 58.1 | 24.3 | 8.1 | 0.4 | 2.9 | 6.2 | 49.4 |
| Card. | 157 | 64.4 | 47.2 | 10.4 | 89.6 | 35.9 | 38.1 | 7.0 | 7.7 | 0.7 | 10.5 | 52.4 |
| Ped. | 303 | 54.6 | 47.7 | 8.3 | 91.7 | 69.7 | 13.9 | 8.2 | 0.9 | 0.2 | 7.2 | 46.1 |
| Surgical | 1254 | 59.1 | 47.3 | 10.3 | 89.7 | 47.0 | 14.1 | 7.2 | 25.5 | 0.4 | 5.8 | 50.1 |
| GS | 262 | 60.1 | 47.6 | 10.8 | 89.2 | 30.3 | 21.7 | 0.1 | 30.9 | 0.7 | 6.4 | 50.5 |
| Ortho. | 162 | 61.9 | 46.7 | 11.1 | 88.9 | 46.5 | 13.7 | 10.6 | 23.4 | 0.5 | 5.3 | 52.1 |
| Optha. | 163 | 51.3 | 47.3 | 12.4 | 87.6 | 75.7 | 3.3 | 3.5 | 13.2 | 0.5 | 3.8 | 42.6 |
| Urol. | 185 | 60.1 | 47.2 | 9.9 | 90.1 | 40.8 | 19.2 | 6.5 | 27.2 | 0.4 | 5.8 | 51.2 |
| Ob/Gyn. | 287 | 61.4 | 47.7 | 8.1 | 91.9 | 54.5 | 11.1 | 5.1 | 24.1 | 0.1 | 5.2 | 53.2 |
| Psych. | 318 | 51.3 | 47.4 | 13.5 | 86.5 | 62.7 | 16.4 | 6.1 | 0 | 1.0 | 13.9 | 38.6 |
| Emer. Med. | 176 | 56.7 | 46.9 | 11.3 | 88.7 | 7.4 | 0.8 | 86.1 | 1.4 | 0.1 | 4.3 | 48.3 |

Source: HCFA-NORC 1984-85 Physician Survey.

Table 5-3 shows that the variation in average hours worked per week across specialities is substantial. Psychiatrists and opthamologists work "only" 51.3 hours on average, while cardiologists work 64.4 hours, a range of 26 percent. The range of variation in weeks worked per year is much smaller. General practitioners work the most weeks, 48.3, while orthopedic surgeons work the fewest, 46.7, a range of only 3 percent. Hence, differences in annual work efffort among specialties are primarily due to variation in hours per week, not weeks per year. On average, physicians spend about 10 percent of their working time on administration and about 90 percent on medical activites. Psychiatrists and opthamologists spend the most time on administration as opposed to medical activities, OBGs and pediatricians the least.

The various specialties distribute their medical time across the five patient care settings quite differently. For GP/FPs, medical specialists, and psychiatrists, the office is the dominant setting, with hospital rounds of secondary importance, and the other settings of even less importance. In this group, cardiologists are an anomaly since they spend more time on hospital rounds than in the office. For surgeons, the office is still generally the most important setting, but the operating theater is, not surprisingly, also an important setting. In this group, opthamologists stand out by spending a much larger than average proportion of their time in the office, and less in the hospital. Emergency medicine specialists are quite different from any others since they spend the great majority of their time in the Er/Opd setting.

The specialty differences in patient-care hours per week are even larger than the differences in total weekly hours. OBGs spend 53.2 hours per week in patient care settings, while psychiatrists spend only 38.6 hours, a range of 38 percent. The larger differences occur because specialty differences in total hours can be magnified by differences in the proportion of administrative versus medical time, and by differences in patient-care versus other medical time. For example, psychiatrists not only work about 10 hours per week less than OBGs, they spend about 5 percent more of their time on administration and about 9 percent more of their medical time on non-patient-care activities. In addition to psychiatrists, opthamologists spend noticeably few hours per week caring for patients. This is due to a low total work effort and a large proportion of time spent on administration. Cardiologists work the most total hours, but have fewer patient-care hours, on average, than do OBGs because they spend an usually large proportion of their medical time on non-patient care activites.

Table 5-4 shows mean visits per hour (intensity), hours per week (weekly work effort), and visits per week (weekly productivity) by specialty and setting. Hours and visits per week are averages for all physicians in the specialty, including those reporting no time in a particular setting. Visits per hour, on the other hand, are averages only for physicians reporting non-zero time in the setting.

Weekly productivity (V/W) in a setting depends on both work effort (H/W) and visit intensity (V/H). For example, emergency medicine specialists produce most of their weekly output of visits in the ER/OPD setting because that is where they spend the great majority of their time. However, visit intensity also has an important effect on the weekly output of visits in a setting. General surgeons, for example, spend more time in the operating suite than on hospital rounds, but produce substantially more hospital visits than operations per week because they see many more patients per hour on hospital rounds.

Table 5-4 emphasizes the problems inherent in using unadjusted visits, compared either across settings or across specialties, as a means by which to judge physician output or productivity. For all specialties, the output of "visits" per hour is lower in the operating suite than in the office setting. This clearly indicates a fundamental difference in the nature of operations compared to office visits, which precludes using a simple sum of the two as a measure of physician output. And, of course, it cannot be concluded that physicians are more productive in the office than the hospital because they complete more visits per hour in the former setting.

The same problems arise in comparing hourly productivity across specialties. Among the specialties shown in Table 5-4, psychiatrists have by far the fewest visits per hour (1.3) in the office setting, while orthopedic surgeons have the most (3.7). The average office visit length of psychiatrist is 52 minutes, while the office visit length of orthopedic surgeons is only 18 minutes (see Table 4-2). These strikingly different visit lengths are clearly due to different specialty casemixes rather than different productivity levels.

TABLE 5-4

INTENSITY AND WEEKLY WORK EFFORT AND PRODUCTIVITY BY SPECIALTY AND SETTING, 1984-85

|  | OFFICE |  |  | HOSPITAL |  |  | ER/OPD |  |  | OPERATIONS |  |  | ECF |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specialty | V/H | H/W | V/W | V/H | H/W | V/W | V/H | H/W | V/W | V/H | H/W | V/W | V/H | H/W | V/W |
| GP/FP | 3.3 | 34.0 | 108.4 | 3.8 | 7.4 | 22.8 | 2.3 | 4.3 | 8.4 | 0.7 | 1.7 | 1.0 | 4.3 | 1.6 | 5.6 |
| GP | 3.3 | 32.9 | 107.4 | 4.0 | 6.4 | 20.6 | 2.5 | 3.4 | 8.6 | 0.7 | 1.5 | .9 | 3.7 | 1.4 | 4.6 |
| FP | 3.3 | 34.5 | 108.9 | 3.7 | 7.9 | 23.8 | 2.2 | 4.7 | 8.3 | 0.7 | 1.8 | 1.1 | 4.6 | 1.6 | 6.1 |
| Medical | 2.6 | 28.7 | 74.4 | 3.2 | 13.1 | 35.3 | 2.1 | 4.3 | 7.9 | 1.0 | 1.3 | 1.0 | 3.2 | 0.9 | 2.5 |
| Int. | 2.4 | 29.8 | 69.8 | 3.2 | 13.4 | 38.3 | 1.8 | 4.5 | 7.0 | 0.7 | 0.3 | 0.2 | 3.2 | 1.6 | 4.2 |
| Card. | 2.1 | 20.3 | 40.1 | 3.0 | 23.0 | 56.2 | 2.1 | 4.4 | 5.8 | 0.7 | 4.5 | 2.6 | 2.0 | 0.4 | 0.6 |
| Ped. | 3.2 | 34.1 | 108.7 | 3.0 | 7.4 | 19.1 | 2.0 | 4.2 | 7.7 | 1.0 | 0.5 | 0.3 | -.- | 0.1 | 0.4 |
| Surgical | 3.3 | 23.6 | 72.4 | 5.1 | 8.1 | 31.2 | 2.1 | 4.2 | 6.2 | 0.6 | 14.3 | 7.4 | 2.4 | 0.2 | 0.4 |
| GS | 3.1 | 15.5 | 42.8 | 6.0 | 12.1 | 43.8 | 1.8 | 5.9 | 7.9 | 0.6 | 17.0 | 8.5 | 2.9 | 0.3 | 0.8 |
| Ortho. | 3.7 | 24.0 | 81.1 | 5.0 | 7.7 | 35.0 | 1.9 | 6.5 | 10.5 | 0.6 | 13.6 | 7.2 | 3.4 | 0.3 | 0.8 |
| Optha. | 3.3 | 33.3 | 105.9 | 3.0 | 1.5 | 3.4 | 1.7 | 1.5 | 2.1 | 0.9 | 6.0 | 5.4 | 1.3 | 0.2 | 0.2 |
| Urol. | 2.8 | 21.8 | 58.0 | 4.8 | 10.8 | 43.5 | 2.5 | 3.8 | 6.2 | 0.6 | 14.8 | 8.8 | 1.7 | 0.2 | 0.4 |
| Ob/Gyn. | 3.2 | 29.0 | 90.B | 5.7 | 6.6 | 26.7 | 2.3 | 3.1 | 5.4 | 0.6 | 14.6 | 6.3 | --- | 0.1 | 0.0 |
| Psych. | 1.3 | 27.6 | 31.6 | 2.6 | 7.5 | 14.9 | 1.6 | 3.1 | 3.9 | --- | 0.0 | 0.0 | 1.6 | 0.5 | 0.8 |
| Emer. Med. | 2.9 | 4.0 | 12.6 | 2.3 | 0.4 | 1.3 | 3.0 | 43.7 | 124.0 | 1.1 | 0.7 | 0.4 | --- | 0.0 | 0.3 |

"--" Indicates too few observations for a reliable estimate.

Source: HCFA-NORC 1984-85 Physician Survey.

## 5.3. Comparison of Physician, Practice, and Area Characteristics by Multi-Setting Productivity Groups

In this section, we examine how the mean values of various determinants of productivity differ across low, average, and high productivity groups for physicians in all specialties. Table 5-5 presents the practice characteristics results, while Table 5-6 displays the physician and area characteristics results. The low, average and high physician groups were defined both for annual productivity (V/Y), and its two components, intensity (V/H), and work effort (H/Y). The intensity and annual productivity groups are based on the time-weighted, specialty-specific index of physician output described in Section 4.2.1. This index aggregates physician visits across five patient-care settings (office, hospital, etc.) and adjusts for specialty differences in average visit length in each setting. We adjusted for specialty work effort differences using the methodology described in Section 4.2.2. The sample of physicians is limited to those for which we constructed an output index, (viz., those specialties listed in Table 4-2 excluding the aggregative categories GP/FP, Medical, and Surgical). Our sample size is then 3,184. Finally, the work effort groups are based on patient care hours, not total work hours.

The numbers in parentheses on the first line of Table 5-5 give the mean of the grouping (productivity) variable for the low, average, and high groups. These numbers show that physician productivity and work effort vary widely. Physicians in the highest third of intensity produce, on average, about three times as much output per hour (1.52) as physicians in the lowest third of intensity (.55). Mean work effort varies by over two times from the lowest (1442 hours) to the highest (3164 hours) third of physician work effort. Proportionately, annual productivity varies the most of all from the lowest (1044) to the highest (3660) third of physicians.

Despite the fact that other factors are not held constant, the descriptive results for most explanatory variables are consistent with theoretical expectations (the construction of the "independent" variables is specified in section 4.2). Equipment, medical supplies, office space, and aides are all practice inputs which, when combined in larger amounts with a given amount of physician time, should lead to a higher rate of practice output. Table 5-5 shows this to be the case. Equipment costs, medical

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TABLE 5-5

PHYSICIAN PRACTICE CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR ALL SETTINGS IN 1984-85: ALL SPECIALTIES*

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| PRACTICE CHARACTERISTICS | INTENSITY (V/H) | | | WORK EFFORT** (H/Y) | | | ANNUAL PRODUCTIVITY (V/Y) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low (.55) | Average (.92) | High (1.52) | Low (1442) | Average (2262) | High (3164) | Low (1044) | Average (2068) | High (3660) |
| Equipment Costs ($/MD) | 3669 | 4622 | 4623 | 2809 | 4024 | 5983 | 3256 | 4050 | 5604 |
| Medical Supplies ($/MD) | 7923 | 11331 | 14466 | 8429 | 10002 | 14734 | 6835 | 10071 | 16340 |
| Office Space per MD | 38.4 | 50.9 | 51.8 | 36.4 | 45.0 | 58.1 | 36.0 | 49.2 | 54.8 |
| Aides per MD | 2.2 | 2.6 | 3.2 | 2.4 | 2.6 | 2.9 | 2.1 | 2.6 | 3.3 |
| Admin. Aides | 1.6 | 1.8 | 2.0 | 1.7 | 1.7 | 1.9 | 1.5 | 1.8 | 2.0 |
| Medical Aides | 0.97 | 1.11 | 1.35 | 1.02 | 1.08 | 1.31 | 0.89 | 1.11 | 1.39 |
| RN's, LPN's Tech. | 0.81 | 0.99 | 1.18 | 0.89 | 0.94 | 1.13 | 0.77 | 0.92 | 1.26 |
| PA's, NP's | 0.16 | 0.12 | 0.21 | 0.13 | 0.17 | 0.18 | 0.13 | 0.18 | 0.17 |
| % Group Practice | 39 | 49 | 55 | 47 | 51 | 46 | 41 | 50 | 53 |
| % Same Specialty | 69 | 65 | 72 | 64 | 70 | 72 | 65 | 69 | 71 |
| % Equal Income Sharers | 35 | 31 | 38 | 33 | 38 | 33 | 33 | 35 | 36 |
| % Self-Employed | 75 | 76 | 75 | 67 | 77 | 81 | 72 | 77 | 78 |
| % AHP Participants | 27 | 33 | 31 | 30 | 33 | 28 | 26 | 34 | 31 |
| Hosp. Adm. (#/week) | 5.5 | 7.4 | 10.4 | 5.7 | 7.6 | 9.8 | 4.7 | 7.1 | 11.4 |
| Office Fee ($) | 30.65 | 30.22 | 27.14 | 29.78 | 29.08 | 29.30 | 30.11 | 30.35 | 27.80 |

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*Productivity groups are based on a specialty-specific, hours-per-visit weighted physician output index. Groups are specialty adjusted (see the Section 4.2.2 for explanation). The numbers in parentheses are the mean values of the grouping variable for the low, average, and high groups (see Section 4.2.1 for discussion of the output index).

**Patient care hours per year.

Source: HCFA NORC 1984-85 Physician Survey.

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TABLE 5-6

PHYSICIAN AND AREA CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR ALL SETTINGS IN 1984-85: ALL SPECIALTIES*

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|  | INTENSITY (V/H) |  |  | WORK EFFORT** (H/Y) |  |  | ANNUAL PRODUCTIVITY (V/Y) |  |  |
|---|---|---|---|---|---|---|---|---|---|
| PHYSICIAN CHARACTERISTICS | Low (.55) | Average (.92) | High (1.52) | Low (1442) | Average (2262) | High (3164) | Low (1044) | Average (2068) | High (3660) |
| % Board Certified | 59 | 65 | 66 | 59 | 66 | 65 | 58 | 64 | 68 |
| % Foreign Grad. | 28 | 19 | 20 | 23 | 21 | 23 | 26 | 21 | 20 |
| % Female | 13 | 8 | 7 | 15 | 8 | 6 | 15 | 8 | 5 |
| Age (yrs) | 49 | 47 | 48 | 50 | 48 | 47 | 50 | 48 | 47 |
| % with Extra Inc. Over 10,000 | 38 | 33 | 34 | 41 | 34 | 30 | 40 | 34 | 31 |
| % Married | 86 | 87 | 91 | 85 | 90 | 89 | 85 | 88 | 91 |
| % Nonwhite | 12 | 12 | 16 | 17 | 16 | 17 | 20 | 14 | 16 |
| AREA CHARACTERISTICS |  |  |  |  |  |  |  |  |  |
| MD's per 100,000 pop. | 212 | 197 | 183 | 213 | 195 | 186 | 217 | 200 | 176 |
| % Urban pop. | 83 | 79 | 76 | 83 | 78 | 77 | 83 | 80 | 76 |
| % Poor pop. | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Inc. per capita ($) | 10330 | 10020 | 9575 | 10314 | 9903 | 9723 | 10426 | 9997 | 9516 |
| Hosp beds per 100,000 pop. | 652 | 651 | 689 | 658 | 671 | 665 | 650 | 663 | 676 |
| % Northeast | 23 | 24 | 25 | 27 | 24 | 21 | 25 | 25 | 22 |
| % North Central | 19 | 22 | 26 | 22 | 22 | 23 | 21 | 21 | 25 |
| % South | 30 | 29 | 34 | 26 | 31 | 36 | 27 | 29 | 37 |
| % West | 27 | 25 | 16 | 25 | 23 | 20 | 27 | 25 | 16 |

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*Productivity groups are based on a specialty-specific, hours-per-visit weighted physician output index. Groups are specialty adjusted (see the Section 4.2.2 for explanation). The numbers in parentheses are the mean values of the grouping variable for the low, average, and high groups (see Section 4.2.1 for discussion of the output index).

**Patient care hours per year.

Source: HCFA NORC 1984-85 Physician Survey.

supplies costs, office space, and aides per physician all increase consistently from low to high intensity and annual productivity groups. For example, the average number of aides per physician in 3.3 in the high annual productivity group compared to only 2.1 in the low group.

Somewhat suprisingly, the number of administrative aides (e.g., secretaries, office managers) and nurses/technicians employed by physicians display the most consistently upward trend from the low to the high productivity groups. The results for more highly-trained physician extenders such as physicians' assistants (PA) and nurse practitioners (NP) is mixed. For intensity (V/H), high productivity physicians use the greatest number of PAs and NPs as expected, but the medium productivity group uses fewer than the low productivity group. For annual productivity (V/Y), the high productivity group uses slightly fewer PAs and NPs that the average productivity group. These results suggest that physician use of less-highly-skilled personnel such as secretaries and nurses more clearly and consistently augments productivity than the employment of the highly-skilled PA's and NP's. Of course, these descriptive results are not based on a rigorously specified production function and so should be interpreted with care.

Many more physicians in group practice (55%) were in the high intensity group than in the low one (only 39%). However, if anything, group practitioners appear to work fewer hours per year than their solo counterparts, although they still see more patients on an annual basis. The effects of group size on productivity are considered below in section 5.5. Group practitioners in the same specialty show slightly higher annual productivity, both because of higher work efforts and higher intensity. This may reflect the greater substitutability of physicians in the same specialty. Although group practitioners sharing practice income equally may have incentives to produce less individually, they appear slightly more productive on both an annual and hourly basis.

Being employed versus self-employed has little effect on intensity but does have a strong effect on work effort. This is consistent with the theoretical expectation that when income is more closely tied to hours worked, as it is for self-employed, fee-for-service physicians than it is for employed, salaried physicians, work effort will be greater. On net, self-employment has a moderately positive effect on annual productivity.

A physician is defined as an alternative health plan (AHP) participant if he participated in a prepaid plan such as an HMO, Independent Practice Association (IPA), or Preferred Provider Organization (PPO). As discussed in section 3.4, we expect participation in an AHP to increase intensity and annual productivity. To the extent that the HMO employee effect dominates the AHP variable, participation should also be associated with lower work effort. Table 5-5 shows that participation in an AHP does tend to have these effects, but that the results are not entirely clear. To more accurately analyze this variable, it is necessary to disaggregate HMO employees and IPA and PPO participants; this is done in section 5.5 below.

The mean number of hospital admissions displays a strongly increasing trend from low to high groups for intensity, work effort, and annual productivity. Physicians who are productive per hour and per year, and who spend more time than average in patient-care activities admit more patients than average to the hospital. There is no suggestion in these results of substitution of inpatient care for other forms of care, but rather a complementarity. The mean office visit fee declines from low to high productivity groups, which is consistent with a lower price stimulating greater demand and hence productivity. Alternately, the higher fee in the low intensity group may reflect the longer, higher-content, higher-quality visits of these physicians.

In Table 5-6, we continue the descriptive analysis of the determinants of productivity, turning now to physician and area characteristics. The proportion of physicians who are board certified increases as productivity increases, which is expected. Additional training should allow physicians to attract more patients and may enable them to produce more efficiently. Inferior training may also explain the lower productivity of foreign medical graduates, although less demand due to discrimination is also likely to explain part of it. Racial discrimination is also expected to lower demand for non-white physicians, making them appear less productive. While this may explain the smaller percentage of non-white physicians in the high annual productivity group than in the low, it is interesting to note that non-white physicians tend to see more patients per hour. This result may reflect a greater tendency for non-white physicians to join HMOs.

Female physicians are less productive than male physicians per hour and per year, and also work fewer hours. Female physicians' lower productivity can be explained by many factors. Women may have different practice "styles" with longer visit lengths. Their lower work effort may be due to social role differentiation, especially greater child-rearing responsibilities, or they may face lower demand due to discrimination. Finally, they are overrepresented in the low work effort specialties (e.g., psychiatry, pediatrics, general practice) and may thus appear to work less in this combined-specialty analysis if our specialty adjustments are not adequate.

The most productive age for physicians is probably in their early fifties, after they have built up their practice, but before their work effort declines towards retirement. Because of these counteracting effects, it is not surprising that average age varies only slightly among productivity groups. An average age of 50 for physicians with low annual productivity compared to only 47 for those with high productivity suggests that leisure preferences dominate the effects of greater experience.

The proportion of physicians with outside income greater than $10,000 falls sharply from low to high work effort groups. This trend indicates that leisure is a normal good, consistent with expectations. The higher productivity of married physicians may indicate a greater preference for income instead of leisure because of the presence of a spouse and children to support.

Among area characteristics, the physician/population ratio has the expected downward trend across productivity and work-effort groups. More physicians per capita means lower demand per physician and hence a lower average work effort and productivity. Since physicians are disproportionately located in urban areas, it is also not surprising that the proportion of urban population declines across productivity and work effort groups.

Lower demand per physician in physician-rich areas could also explain the lower average per capita income in the higher productivity and work effort groups because physician/population ratios are higher in wealthier areas. An alternative explanation for the differences in per capita income among productivity groups is that patients in wealthier areas have a higher time price and demand higher-quality, longer visits so that physicians in these areas have more downtime to reduce patient waiting time and spend more time per visit. Apparently, these two effects dominate the presumably higher demand for physicians' services in wealthier areas, which could lead to higher physician productivity in those areas.

Although we would expect physician productivity to be lower in poorer areas because of insufficient demand, the percent of poor people in the country varies only slightly across productivity groups. This relationship may be obscured because physicians tend not to locate in poorer areas, resulting in limited physician availability and higher individual physician demand.

The mean number of hospital beds per capita is greater for the high productivity than low productivity groups. This implies that hospital beds are complements to physicians. That is, more hospital beds increase the demand for physicians, leading to higher physician productivity. The effect of hospital beds on work effort is not clear from Table 5-6, however. Other measures of hospital availability, such as emergency room or outpatient department capacity per capita, might show a substitution rather than a complementary relationship with physicians' services.

The last four area variables give the proportion of physicians in each productivity or work effort group in each of the four Census regions. Northeast physicians are slightly above average in intensity, below average in work effort, and slightly below average in annual productivity. North Central physicians see more patients per hour than physicians in other areas, but have an average work effort. They are slightly overrepresented in the highest third of annual productivity. Southern physicians have an above average intensity, well-above-average work effort, and well-above-average annual productivity. Western physicians are much below average in hourly productivity, below average in work effort, and much below average in annual productivity. Whether these regional differences are due to regional demand variations, regional practice styles, or other factors is an interesting subject for further research.

## 5.4 Productivity Analysis for the Office Setting

### 5.4.1 Comparison of Physician, Practice, and Area Characteristics by Productivity: All Specialties

Table 5-7 shows that most of the factors influencing total physician productivity have a similar effect on productivity in the office setting. Physician inputs, such as equipment, medical supplies, office space and non-physician aides, are all positively correlated with productivity in the office setting. However, while equipment costs increase between low and high productivity groups, they are the highest for physicians with average work efforts and an average number of visits per hour.

As in other settings, group practitioners in the office setting see more patients per hour than solo practitioners, with 50 percent represented in the high intensity group compared to only 40 percent in the low group. However, group practitioners show a lower work effort in the office setting than their solo counterparts. Since this trend was not evident for work effort across all settings, it is likely that group practitioners spend more time in other settings (e.g. hospitals and clinics). In spite of a lower work effort, group physicians are more productive annually in the office setting than solo physicians.

Physicians sharing income equally among their group work fewer hours per year in the office than group practitioners not sharing income equally (38 percent of the low productivity group are equal income sharers compared to only 30 percent in the high productivity group). The negative work effort effect for physicians sharing income equally outweighs their higher intensity, resulting in no clear overall productivity trend in the office setting.

Self-employed physicians not only work longer hours in the office setting, they work more intensively than employees. However since no clear intensity trend is apparent for self-employed physicians across all settings, they must be seeing fewer patients per hour in other settings.

There were few differences in the effects of physician characteristics on productivity between the office setting and other settings. The most notable difference was that non-white physicians see fewer patients per hour than white physicians in the office setting (see Table 5-8). There were more differences in the effects of area characteristics on productivity in the office, particularly with respect to region. For example, physicians in the

TABLE 5-7

PRACTICE CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR OFFICE SETTING IN 1984-85: ALL SPECIALTIES*

| PRACTICE CHARACTERISTICS | INTENSITY (V/H) Low (1.5) | INTENSITY (V/H) Average (2.6) | INTENSITY (V/H) High (4.5) | WORK EFFORT* (H/Y) Low (841) | WORK EFFORT* (H/Y) Average (1378) | WORK EFFORT* (H/Y) High (1983) | ANNUAL PRODUCTIVITY (V/Y) Low (1748) | ANNUAL PRODUCTIVITY (V/Y) Average (3650) | ANNUAL PRODUCTIVITY (V/Y) High (6337) |
|---|---|---|---|---|---|---|---|---|---|
| Equipment Costs ($/MD) | 3450 | 5160 | 4487 | 3337 | 5634 | 4118 | 13120 | 4700 | 5254 |
| Medical Supplies ($/MD) | 7351 | 11778 | 14952 | 9393 | 11281 | 13316 | 16575 | 12213 | 14886 |
| Office Space per MD | 38.9 | 49.9 | 54.5 | 41.6 | 50.8 | 49.1 | 36.9 | 47.9 | 55.8 |
| Aides per MD | 2.2 | 2.6 | 3.3 | 2.5 | 2.7 | 2.9 | 2.1 | 2.7 | 3.3 |
| Admin. Aides | 1.6 | 1.8 | 2.0 | 1.8 | 1.7 | 1.8 | 1.5 | 1.8 | 2.0 |
| Medical Aides | 0.97 | 1.07 | 1.39 | 1.01 | 1.14 | 1.27 | 0.85 | 1.10 | 1.43 |
| RN's, LPN's Tech. | 0.82 | 0.94 | 1.22 | 0.87 | 1.03 | 1.09 | 0.72 | 0.93 | 1.30 |
| PA's, NP's | 0.15 | 0.13 | 0.21 | 0.15 | 0.15 | 0.18 | 0.14 | 0.18 | 0.17 |
| % Group Practice | 40 | 48 | 51 | 48 | 47 | 45 | 42 | 49 | 49 |
| % Same Specialty | 68 | 67 | 69 | 68 | 70 | 67 | 68 | 67 | 69 |
| % Equal Income Sharers | 31 | 35 | 37 | 38 | 37 | 30 | 36 | 34 | 35 |
| % Self-Employed | 77 | 79 | 81 | 71 | 82 | 83 | 73 | 80 | 84 |
| % AHP Participants | 27 | 33 | 31 | 30 | 31 | 30 | 27 | 32 | 31 |
| Hosp. Adm. (#/week) | 5.5 | 6.7 | 10.3 | 7.2 | 7.7 | 7.5 | 5.4 | 7.0 | 9.9 |
| Office Fee ($) | 29.42 | 31.31 | 27.45 | 28.36 | 29.67 | 30.07 | 29.96 | 30.27 | 28.28 |

* Productivity groups are specialty adjusted (see Section 4.2.2 for explanation).

Source: HCFA-NORC 1984-85 Physician Survey.

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TABLE 5-8

PHYSICIAN AND AREA CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR OFFICE SETTING IN 1984-85: ALL SPECIALTIES*

| | INTENSITY (V/H) | | | WORK EFFORT* (H/Y) | | | ANNUAL PRODUCTIVITY (V/Y) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low (1.5) | Average (2.6) | High (4.5) | Low (841) | Average (1378) | High (1983) | Low (1748) | Average (3650) | High (6337) |
| PHYSICIAN CHARACTERISTICS | | | | | | | | | |
| % Board Certified | 60 | 67 | 66 | 62 | 65 | 66 | 60 | 65 | 68 |
| % Foreign Grad. | 28 | 18 | 22 | 25 | 22 | 22 | 28 | 19 | 20 |
| % Female | 12 | 9 | 6 | 12 | 8 | 7 | 14 | 7 | 6 |
| Age (yrs) | 49 | 48 | 49 | 49 | 49 | 48 | 49 | 48 | 48 |
| % with Extra Inc. Over 10,000 | 37 | 33 | 35 | 39 | 37 | 30 | 39 | 35 | 32 |
| % Married | 86 | 90 | 91 | 88 | 90 | 90 | 86 | 90 | 91 |
| % Nonwhite | 21 | 12 | 18 | 18 | 16 | 16 | 21 | 13 | 16 |
| AREA CHARACTERISTICS | | | | | | | | | |
| MD's per 100,000 pop. | 209 | 202 | 178 | 206 | 195 | 193 | 214 | 195 | 182 |
| % Urban pop. | 82 | 80 | 76 | 81 | 78 | 80 | 82 | 80 | 77 |
| % Poor pop. | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Inc. per capita ($) | 10307 | 10058 | 9559 | 10073 | 9896 | 9965 | 10304 | 10016 | 9611 |
| Hosp. beds per 100,000 pop. | 648 | 667 | 672 | 696 | 640 | 644 | 670 | 653 | 662 |
| % Northeast | 24 | 24 | 23 | 28 | 23 | 22 | 27 | 22 | 23 |
| % North Central | 19 | 22 | 25 | 25 | 23 | 19 | 22 | 22 | 22 |
| % South | 31 | 29 | 34 | 28 | 31 | 35 | 29 | 29 | 35 |
| % West | 26 | 25 | 17 | 19 | 24 | 25 | 22 | 27 | 20 |

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* Productivity groups are specialty adjusted (see Section 4.2.2 for explanation).

Source: HCFA-NORC 1984-85 Physician Survey.

West tend to work more hours in the office setting and fewer in other settings (25 percent of the physicians working long office hours reside in the west vs. only 19 percent working short hours). By contrast, physicians in the North Central region tend to work fewer hours in the office setting than in other settings. Longer office hours for western physicians suggests that they may be spending more time in the office on administrative tasks due to decreased demand.

Not surprisingly, the availability of hospital care (hospital beds per 100,000 population) is not strongly associated with productivity in the office setting, although, if anything the trends are similar to those in other settings. While a positive correlation between office productivity and hospital admissions exists, it is also not as strong in the office-setting as in the all-setting comparison.

### 5.4.2 Specialty-Specific Comparison of Physician, Practice and Area Characteristics by Productivity Group

To analyze physician productivity groups by descriptive practice, physician, and area characteristics at the specialty level, we limited the number of descriptive variables analysed both to avoid small sample sizes and redundancy. The problem of small samples sizes also necessitated limiting the number of productivity groups to only two (i.e., high and low groups) for some variables. Even with only two groups, the paucity of certain categories of physicians (e.g., female general surgeons or psychiatrists in group practices that share income equally) preclude analysis of some variables for some specialties. The six specialties analysed in this section range in sample size from a minimum of 262 general surgeons to a maximum of 699 GPs and FPs.

Like the results for all physicians in the office setting, equipment costs and the number of non-physician personnel are higher for more productive GPs and FPs (see Table 5-9). This is especially true for average equipment costs in annual productivity groups. The use of administrative aides (e.g.

secretaries) appears to be responsible for most of the increased intensity between low and average groups while the use of medical aides contributes more to increasing intensity at higher productivity levels. GPs and FPs in single-specialty groups see more patients per hour and work longer hours than other specialists. However, among GPs and FPs in group practice, sharing income equally seems to have little effect on productivity.

As expected, self-employed GPs and FPs tend to see more patients per hour and work more hours per year. Like other specialists, GPs and FPs in group practice work more intensively. However, they do not show lower work efforts. GPs and FPs sharing income equally within their group also work the same hours per year as their counterparts with greater incentive to work harder. Similar to the all-specialty results, board certified male physicians who attended U.S. medical colleges see more patients per hour and per year than other physicians. However, foreign medical graduates and female physicians do not work fewer hours per year than their counterparts. This result suggests that lower productivity for these physicians may be demand-related.

A much stronger age effect is evident for GP and FP productivity than for all specialties combined. Older physicians with higher preference for leisure time rather than less-experienced younger physicians dominate the low productivity groups. Not surprisingly, this effect is especially evident for the work effort measure, with average physician age ranging from 54 in the low productivity group to 48 in the high one.

While GPs and FPs in physician-scarce areas see more patients per hour and per year, they do not appear to work more hours per year since the physician density in the low work effort group was 149 physicians per 100,000 population compared to 150 in the high group. This is in contrast to an inverse relationship between work effort and physician availability for all specialties.

Turning to the results for internists in Table 5-10, we note a few exceptions to earlier trends. First, although there is no decrease in the proportion of group-practice internists in high intensity and work effort

TABLE 5-9

PRACTICE, PHYSICIAN, AREA CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR OFFICE SETTING IN 1984-85: GP/FP

| | INTENSITY (V/H) | | | WORK EFFORT* (H/Y) | | | ANNUAL PRODUCTIVITY (V/Y) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low (1.6) | Average (3.0) | High (5.3) | Low (1031) | Average (1649) | High (2267) | Low (2291) | Average (4909) | High (8646) |
| **PRACTICE CHARACTERISTICS** | | | | | | | | | |
| Equipment Costs ($/MD) | 3305 | 5239 | 3622 | 3123 | 5200 | 3803 | 2618 | 4242 | 5113 |
| Admin. Aides (#/MD) | 1.4 | 1.9 | 1.9 | 1.6 | 1.8 | 1.9 | 1.5 | 1.8 | 2.0 |
| Medical Aides (#/MD) | 1.0 | 1.2 | 1.4 | 0.9 | 1.2 | 1.5 | 0.8 | 1.1 | 1.3 |
| % Self-Employed | 81 | -- | 83 | 81 | -- | 82 | 79 | -- | 85 |
| % AHP Participants | 24 | -- | 26 | 25 | -- | 26 | 22 | -- | 28 |
| % Group Practice | 42 | -- | 48 | 45 | -- | 47 | 45 | -- | 47 |
| % Same Specialty | 59 | -- | 67 | 59 | -- | 67 | 57 | -- | 68 |
| % Equal Income Sharers | 35 | -- | 33 | 35 | -- | 35 | 37 | -- | 38 |
| Office Fee ($) | 22.58 | 22.25 | 20.65 | 21.26 | 22.72 | 21.51 | 21.75 | 23.69 | 20.05 |
| **PHYSICIAN CHARACTERISTICS** | | | | | | | | | |
| % Board Certified | 45 | -- | 50 | 45 | -- | 51 | 43 | -- | 52 |
| % Foreign Graduates | 21 | -- | 18 | 19 | -- | 21 | 22 | -- | 18 |
| % Female | 11 | -- | 4 | 7 | -- | 7 | 10 | -- | 5 |
| Age (yrs) | 53 | 49 | 51 | 54 | 51 | 48 | 55 | 49 | 49 |
| % with Extra Inc. Over $10,000 | 32 | -- | 35 | 38 | -- | 30 | 36 | -- | 33 |
| % Married | 87 | -- | 92 | 90 | -- | 90 | 89 | -- | 91 |
| % Nonwhite | 14 | -- | 11 | 13 | -- | 11 | 15 | -- | 9 |
| **AREA CHARACTERISTICS** | | | | | | | | | |
| MD's per 100,000 pop. | 165 | 147 | 132 | 149 | 146 | 150 | 156 | 158 | 131 |
| % Urban pop. | 72 | 70 | 61 | 69 | 65 | 69 | 70 | 71 | 61 |
| % poor pop. | 12 | 12 | 14 | 12 | 13 | 12 | 12 | 12 | 13 |

Source: HCFA-NORC 1984-85 Physician Survey.

TABLE 5-10

PRACTICE, PHYSICIAN, AREA CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR OFFICE SETTING IN 1984-85: INTERNISTS

| | INTENSITY (V/H) | | | WORK EFFORT (H/Y) | | | ANNUAL PRODUCTIVITY (V/Y) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low (1.2) | Average (2.2) | High (3.7) | Low (850) | Average (1445) | High (2043) | Low (1500) | Average (3049) | High (5610) |
| PRACTICE CHARACTERISTICS | | | | | | | | | |
| Equipment Costs ($/MD) | 2499 | 7631 | 4898 | 3642 | 6982 | 4244 | 2964 | 7389 | 4395 |
| Admin. Aides (#/MD) | 1.6 | 1.5 | 1.9 | 1.8 | 1.6 | 1.7 | 1.5 | 1.6 | 1.8 |
| Medical Aides (#/MD) | 0.6 | 0.7 | 1.0 | 0.6 | 0.8 | 0.9 | 0.5 | 0.7 | 1.8 |
| % Self-Employed | 75 | -- | 80 | 73 | -- | 81 | 70 | -- | 84 |
| % AHP Participants | 32 | -- | 30 | 33 | -- | 29 | 29 | -- | 33 |
| % Group Practice | 44 | -- | 44 | 44 | -- | 44 | 46 | -- | 43 |
| % Same Specialty | 53 | -- | 48 | 52 | -- | 50 | 59 | -- | 42 |
| % Equal Income Sharers | 29 | -- | 22 | 27 | -- | 28 | 26 | -- | 26 |
| Office Fee ($) | 29.35 | 26.56 | 24.65 | 26.66 | 26.48 | 26.48 | 29.26 | 26.12 | 25.09 |
| PHYSICIAN CHARACTERISTICS | | | | | | | | | |
| % Board Certified | 63 | -- | 60 | 61 | -- | 62 | 64 | -- | 59 |
| % Foreign Graduates | 25 | -- | 29 | 31 | -- | 25 | 26 | -- | 29 |
| % Female | 11 | -- | 6 | 12 | -- | 5 | 13 | -- | 4 |
| Age (yrs) | 48 | 46 | 48 | 47 | 49 | 47 | 47 | 47 | 48 |
| % with Extra Inc. Over $10,000 | 40 | -- | 32 | 45 | -- | 27 | 45 | -- | 27 |
| % Married | 86 | -- | 88 | 87 | -- | 85 | 87 | -- | 86 |
| % Nonwhite | 18 | -- | 27 | 26 | -- | 21 | 20 | -- | 26 |
| AREA CHARACTERISTICS | | | | | | | | | |
| MD's per 100,000 pop. | 238 | 214 | 191 | 223 | 223 | 201 | 240 | 210 | 196 |
| % Urban population | 87 | 83 | 80 | 85 | 84 | 82 | 86 | 84 | 80 |
| % Poor population. | 12 | 12 | 12 | 12 | 12 | 11 | 12 | 12 | 12 |

Source: HCFA-NORC 1984-85 Physician Survey.

groups, 46 percent of internists with low annual productivity are in group practice compared to only 43 percent of high productivity internists. Not only is this relationship in sharp contrast to earlier findings for other specialists, but it suggests a fairly strong inverse relationship between visit intensity and work effort for internists. This inverse relationship must also explain the increase in AHP participation between annual productivity groups in spite of decreased participation across intensity and work effort groups.

In contrast to GPs and FPs, AHP participation enhances the annual productivity of internists, perhaps because internists are more likely to be employed in HMOs than say GPs. Assuming that HMO employees work more intensively, the higher productivity of internists in multi-specialty group practices is also understandable, since these groups include HMOs.

Unlike other board-certified specialists, board-certified internists see fewer patients per hour and per year in the office. This may be because higher trained internists are treating more severely ill patients requiring longer visits. Certainly, the average fee is higher for internists seeing the fewest patients per hour, possibly suggesting higher quality visits.

In sharp contrast to the GP-FP results, FMGs and non-white internists are more productive on both a per-hour and per-year basis, although they tend to work fewer hours per year. These results may also reflect an HMO effect if FMGs and non-white physicians are more likely than other physicians to participate in HMOs (say to increase their demand).

The results for pediatricians in Table 5-11 are quite similar to the results for GPs and all-specialties. The most notable exception is that while equipment costs are positively correlated with work effort and annual productivity, they are negatively correlated with intensity. The negative correlation with intensity may reflect confounding casemix factors. For example, pediatricians treating sicker children are likely to have longer visits and use more expensive equipment.

In spite of smaller sample sizes, most of the results for OBGs and for

TABLE 5-11

PRACTICE, PHYSICIAN, AREA CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR OFFICE SETTING IN 1984-85: PEDIATRICS

| | INTENSITY (V/H) | | | WORK EFFORT (H/Y) | | | ANNUAL PRODUCTIVITY (V/Y) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low (1.7) | Average (3.1) | High (4.8) | Low (1115) | Average (1749) | High (2401) | Low (2414) | Average (5359) | High (8937) |
| PRACTICE CHARACTERISTICS | | | | | | | | | |
| Equipment Costs ($/MD) | 3207 | 2689 | 2786 | 2471 | 3176 | 3135 | 3303 | 2195 | 3589 |
| Admin. Aides (#/MD) | 1.2 | 1.5 | 1.9 | 1.5 | 1.5 | 1.6 | 1.1 | 1.6 | 1.8 |
| Medical Aides (#/MD) | 0.7 | 0.9 | 1.6 | 0.8 | 1.4 | 1.0 | 0.6 | 0.9 | 1.7 |
| % Self-Employed | 62 | -- | 73 | 61 | -- | 74 | 59 | -- | 77 |
| % AHP Participants | 35 | -- | 38 | 36 | -- | 37 | 37 | -- | 37 |
| % Group Practice | 56 | -- | 63 | 61 | -- | 59 | 58 | -- | 62 |
| % Same Specialty | 63 | -- | 69 | 56 | -- | 74 | 64 | -- | 68 |
| % Equal Income Sharers | 39 | -- | 40 | 45 | -- | 36 | 43 | -- | 38 |
| Office Fee ($) | 21.70 | 20.85 | 21.13 | 21.35 | 21.71 | 21.06 | 21.39 | 21.79 | 20.79 |
| PHYSICIAN CHARACTERISTICS | | | | | | | | | |
| % Board Certified | 58 | -- | 78 | 64 | -- | 70 | 67 | -- | 76 |
| % Foreign Graduates | 35 | -- | 24 | 36 | -- | 23 | 40 | -- | 19 |
| % Female | 31 | -- | 23 | 36 | -- | 36 | 40 | -- | 16 |
| Age (yrs) | 47 | 44 | 47 | 46 | 45 | 46 | 46 | 45 | 46 |
| % with Extra Inc. Over $10,000 | 48 | -- | 36 | 44 | -- | 39 | 50 | -- | 34 |
| % Married | 90 | -- | 89 | 87 | -- | 93 | 87 | -- | 92 |
| % Nonwhite | 34 | -- | 16 | 27 | -- | 22 | 33 | -- | 17 |
| AREA CHARACTERISTICS | | | | | | | | | |
| MD's per 100,000 pop. | 214 | 202 | 190 | 240 | 192 | 186 | 232 | 197 | 176 |
| % Urban population | 86 | 82 | 84 | 87 | 82 | 82 | 86 | 83 | 82 |
| % Poor population | 13 | 12 | 11 | 12 | 12 | 12 | 13 | 11 | 11 |

Source: HCFA-NORC 1984-85 Physician Survey.

General Surgeons conform fairly well to general trends (see Tables 5-12 and 5-13 respectively). Again, equipment costs decreased between low and high intensity groups, suggesting that like Pediatricians, OBGs and General Surgeons with longer office visits have higher equipment costs. The results may also reflect differences among physicians in the amount of time they spend in the office versus hospital setting. For example if general surgeons working intensively in the office setting spend more of their time in the hospital setting and thus have more access to hospital equipment, they may require less office equipment.

Another unexpected finding is the similarity across annual productivity groups with respect to the employment status of OBGs. This result is particularly surprising given that self-employed OBGs both see more patients per hour and work longer hours. Again, this suggests a strong inverse relationship between intensity and work effort. OBGs (like internists) seeing many patients per hour must work fewer hours overall. Similar to GPs and FPs, OBGs participating in AHPs tend to see more patients on both an hourly and annual basis, although they work fewer hours per year.

By contrast, general surgeons participating in AHPs tend to be less productive, although this finding must be interpreted cautiously due to the small sample size for this specialty. General surgeons also differ from other specialists with respect to the effects of age and outside income on productivity. Older general surgeons see more patients per hour and work more hours per year in the office, while general surgeons with outside incomes of more than $10,000 work more hours per year in the office.

Although psychiatrists differ greatly from other specialties (e.g., fewer aides, lower equipment costs, higher fees and less group practice), the trends in productivity groups are quite similar to other large specialties (see Table 5-14). One notable difference is that equipment costs are higher in low productivity groups for all measures. Psychiatrists seeing more patients per hour not only have lower equipment costs, they have higher office fees on average. Demand factors may be confounding this relationship, since

TABLE 5-12

PRACTICE, PHYSICIAN, AREA CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR OFFICE SETTING IN 1984-85: OBSTETRICS AND GYNECOLOGY

| | INTENSITY (V/H) | | | WORK EFFORT (H/Y) | | | ANNUAL PRODUCTIVITY (V/Y) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low (1.6) | Average (3.1) | High (4.9) | Low (904) | Average (1382) | High (1902) | Low (2007) | Average (4129) | High (6975) |
| PRACTICE CHARACTERISTICS | | | | | | | | | |
| Equipment Costs ($/MD) | 4665 | 7627 | 3897 | 2806 | 7246 | 6322 | 4376 | 4831 | 7426 |
| Admin. Aides (#/MD) | 1.8 | 1.5 | 1.9 | 1.5 | 1.8 | 1.8 | 1.6 | 1.6 | 1.9 |
| Medical Aides (#/MD) | 0.9 | 0.9 | 1.3 | 0.8 | 1.1 | 1.2 | 0.8 | 1.0 | 1.4 |
| % Self-Employed | 81 | -- | 85 | 79 | -- | 85 | 83 | -- | 83 |
| % AHP Participants | 28 | -- | 37 | 35 | -- | 30 | 25 | -- | 41 |
| % Group Practice | 49 | -- | 61 | 59 | -- | 51 | 47 | -- | 62 |
| % Same Specialty | 77 | -- | 78 | 72 | -- | 81 | 76 | -- | 78 |
| % Equal Income Sharers | 38 | -- | 44 | 46 | -- | 36 | 49 | -- | 35 |
| Office Fee ($) | 31.28 | 29.76 | 27.94 | 29.58 | 29.69 | 30.04 | 31.13 | 29.41 | 28.88 |
| PHYSICIAN CHARACTERISTICS | | | | | | | | | |
| % Board Certified | 61 | -- | 77 | 69 | -- | 69 | 64 | -- | 73 |
| % Foreign Graduates | 27 | -- | 21 | 28 | -- | 20 | 29 | -- | 20 |
| % Female | 17 | -- | 5 | 10 | -- | 13 | 15 | -- | 7 |
| Age (yrs) | 48 | 47 | 48 | 48 | 47 | 47 | 48 | 49 | 46 |
| % with Extra Inc. Over $10,000 | 36 | -- | 38 | 40 | -- | 33 | 36 | -- | 37 |
| % Married | 92 | -- | 93 | 92 | -- | 92 | 91 | -- | 91 |
| % Nonwhite | 21 | -- | 12 | 18 | -- | 15 | 19 | -- | 14 |
| AREA CHARACTERISTICS | | | | | | | | | |
| MD's per 100,000 pop. | 206 | 210 | 195 | 212 | 213 | 194 | 217 | 192 | 202 |
| % Urban population | 85 | 85 | 79 | 84 | 82 | 84 | 84 | 82 | 83 |
| % Poor population | 12 | 12 | 13 | 12 | 12 | 12 | 12 | 13 | 12 |

Source: HCFA-NORC 1984-85 Physician Survey.

TABLE 5-13

PRACTICE, PHYSICIAN, AREA CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR OFFICE SETTING IN 1984-85: GENERAL SURGEONS

| | INTENSITY (V/H) | | | WORK EFFORT (H/Y) | | | ANNUAL PRODUCTIVITY (V/Y) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low (1.5) | Average (2.8) | High (5.4) | Low (342) | Average (658) | High (1269) | Low (760) | Average (1818) | High (3723) |
| PRACTICE CHARACTERISTICS | | | | | | | | | |
| Equipment Costs ($/MD) | 2979 | 2210 | 2619 | 2319 | 2808 | 2721 | 2426 | 3147 | 2262 |
| Admin. Aides (#/MD) | 1.3 | 1.5 | 1.8 | 1.6 | 1.3 | 1.8 | 1.3 | 1.6 | 1.8 |
| Medical Aides (#/MD) | 0.5 | 0.6 | 0.8 | 0.4 | 0.6 | 0.8 | 0.3 | 0.7 | 0.8 |
| % Self-Employed | 84 | -- | 87 | 82 | -- | 89 | 81 | -- | 89 |
| % AHP Participants | 25 | -- | 24 | 34 | -- | 17 | 28 | -- | 21 |
| % Group Practice | 33 | -- | 49 | 47 | -- | 36 | 38 | -- | 44 |
| % Same Specialty | 59 | -- | 65 | 75 | -- | 48 | 67 | -- | 58 |
| % Equal Income Sharers | 43 | -- | 57 | 56 | -- | 37 | 40 | -- | 56 |
| Office Fee ($) | 23.47 | 24.95 | 19.01 | 21.86 | 22.30 | 22.53 | 24.50 | 22.61 | 20.10 |
| PHYSICIAN CHARACTERISTICS | | | | | | | | | |
| % Board Certified | 75 | -- | 77 | 79 | -- | 72 | 76 | -- | 75 |
| % Foreign Graduates | 30 | -- | 25 | 27 | -- | 28 | 28 | -- | 27 |
| % Female | 1 | -- | 0 | 1 | -- | 0 | 1 | -- | 1 |
| Age (yrs) | 51 | 51 | 52 | 49 | 51 | 53 | 49 | 51 | 53 |
| % with Extra Inc. Over $10,000 | 37 | -- | 37 | 32 | -- | 41 | 34 | -- | 40 |
| % Married | 89 | -- | 97 | 94 | -- | 93 | 88 | -- | 98 |
| % Nonwhite | 23 | -- | 23 | 20 | -- | 27 | 24 | -- | 23 |
| AREA CHARACTERISTICS | | | | | | | | | |
| MD's per 100,000 pop. | 196 | 207 | 169 | 214 | 167 | 202 | 217 | 185 | 169 |
| % Urban population | 80 | 77 | 75 | 82 | 73 | 78 | 83 | 77 | 72 |
| % Poor population | 12 | 12 | 13 | 12 | 12 | 13 | 12 | 12 | 13 |

Source: HCFA-NORC 1984-85 Physician Survey.

TABLE 5-14

PRACTICE, PHYSICIAN, AREA CHARACTERISTICS BY PRODUCTIVITY GROUPS FOR OFFICE SETTING IN 1984-85: PSYCHIATRISTS

| | INTENSITY (V/H) | | | WORK EFFORT (H/Y) | | | ANNUAL PRODUCTIVITY (V/Y) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low (0.7) | Average (1.0) | High (1.9) | Low (714) | Average (1330) | High (2041) | Low (728) | Average (1502) | High (2474) |
| PRACTICE CHARACTERISTICS | | | | | | | | | |
| Equipment Costs ($/MD) | 890 | 440 | 687 | 466 | 844 | 453 | 704 | 899 | 224 |
| Admin. Aides (#/MD) | 1.1 | 1.1 | 1.4 | 1.2 | 1.3 | 1.2 | 1.2 | 1.2 | 1.3 |
| Medical Aides (#/MD) | 0.2 | 0.4 | 0.7 | 0.2 | 1.0 | 0.2 | 0.2 | 1.1 | 0.2 |
| % Self-Employed | 74 | -- | 70 | 59 | -- | 84 | 61 | -- | 83 |
| % AHP Participants | 17 | -- | 27 | 21 | -- | 22 | 21 | -- | 22 |
| % Group Practice | 14 | -- | 23 | 21 | -- | 17 | 19 | -- | 18 |
| % Same Specialty | 87 | -- | 81 | 91 | -- | 77 | 90 | -- | 77 |
| % Equal Income Sharers | 0 | -- | 15 | 20 | -- | 0 | 11 | -- | 8 |
| Office Fee ($) | 70.69 | 71.70 | 75.71 | 74.33 | 72.61 | 71.44 | 73.15 | 72.1 | 73.0 |
| PHYSICIAN CHARACTERISTICS | | | | | | | | | |
| % Board Certified | 61 | -- | 56 | 53 | -- | 64 | 53 | -- | 65 |
| % Foreign Graduates | 21 | -- | 22 | 24 | -- | 18 | 21 | -- | 22 |
| % Female | 18 | -- | 13 | 18 | -- | 14 | 19 | -- | 12 |
| Age (yrs) | 49 | 50 | 50 | 49 | 49 | 51 | 50 | 50 | 49 |
| % with Extra Inc. Over $10,000 | 45 | -- | 42 | 44 | -- | 41 | 48 | -- | 39 |
| % Married | 79 | -- | 89 | 83 | -- | 84 | 82 | -- | 85 |
| % Nonwhite | 13 | -- | 19 | 18 | -- | 14 | 12 | -- | 19 |
| AREA CHARACTERISTICS | | | | | | | | | |
| MD's per 100,000 pop. | 260 | 276 | 211 | 234 | 261 | 263 | 251 | 268 | 236 |
| % Urban population | 88 | 92 | 83 | 86 | 86 | 92 | 88 | 86 | 89 |
| % Poor population | 13 | 11 | 11 | 12 | 12 | 12 | 12 | 12 | 11 |

*Includes psychologists and sociologists for this specialty.

Source: HCFA-NORC 1984-85 Physician Survey.

psychiatrists with greater market control may be able to charge higher fees.

Another unexpected finding is that non-white psychiatrists and FMGs see more patients per hour than other physicians. For non-white psychiatrists, this effect dominates a lower work effort effect so that annual productivity is also higher.

Overall, the specialty-specific analysis of productivity in the office setting tends to confirm the results of the combined-specialty analysis. A couple of important differences are evident however. First, the sharp decline in female physician work effort evident in the combined-specialty analysis is less noticeable in the specialty-specific analysis. Second, the effects of age and AHP participation are more clear on a specialty-specific basis. Finally, for some specialties (e.g. internists and OBGs) there is a strong negative relationship between visit intensity and work effort.

The results of this analysis are also similar to findings from an earlier specialty-specific study using 1976-78 HCFA-NORC data (see Cromwell and Hurdle, 1984). For comparison purposes, the main results of the earlier study are shown in Appendix A.

### 5.5 Effects of Practice Size on Productivity

In the literature on physician productivity, two reforms of medical practice arrangements are often cited as potential sources of reductions in physician requirements: (1) the formation of group as opposed to solo practices; and (2) the development of prepaid alternative health plans such as HMOs and IPAs (Reinhardt, 1975). Section 5.5 provides some descriptive evidence from the 1984-85 HCFA-NORC Physician Survey on the effects of group size on physician productivity. Section 5.6 considers the effects of participation in alternative health plans on productivity. In these sections, we invert the "productivity group" methodology we have used elsewhere in Chapter 5. That is, in sections 5.5 and 5.6 the means of practice size and AHP variables are not reported by low, medium, and high productivity groups. Instead, the means of six productivity variables are reported by practice size and AHP participation, both for combined specialties and for GP/FPs only. Multi-setting output is measured by the specialty-specific time-weighted visit index described in Section 4.2.1. It is reported per hour and per year together with total medical hours. Output in the office setting is measured by office visits, which are reported per hour and per year, together with office hours. The multi-setting output index is specialty-adjusted in the sense that specialty differences in mean visit length are accounted for (see Section 4.2.1). Office visits and hours worked for the all-specialty analysis are averaged unadjusted, however. The GP/FP results isolate the effects of group size and AHP participation from specialty differences; they are, of course, specific to GP/FPs.

The sample for the combined-specialty analyses of both Sections 5.5 and 5.6 consists of the following specialties: GP/FPs, internists, cardiologists, pediatricians, opthamologists, urologist, OBGs, psychiatrists, emergency medicine specialists, and general and orthopedic surgeons. RAPs (N=970) are excluded from all analyses in this report. "Other medical" (N=269), "other surgical" (N=195) and "other specialties" (N=111) are excluded from the analyses in these two sections because no aggregate output index was created for them. These exclusions reduce the original NORC sample of 4729 to 3184. Moreover, hospital employees were not asked either the practice size or the AHP participation questions, further reducing the sample for the combined specialty and for the GP/FP analyses. However, physicians employed by a clinic or HMO or by another physician or a corporation are included in the analyses, together with self-employed, partner, or part-owner physicians.

The literature on practice size and physician productivity indicates that physicians in small group practices are most productive, with physicians in both solo and large group practices less productive (see Section 2.2). Productivity is thus an inverted U-shaped curve with respect to group size. Our descriptive results, reported in Table 5-15, partially confirm this hypothesis. The output of group physicians is consistently higher than that of solo physicians, for all group sizes. This result holds for all settings or only the office setting, for output per hour or per year, and for combined

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TABLE 5-15

MEAN PHYSICIAN PRODUCTIVITY BY PRACTICE SIZE, 1984-85

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I. Combined Specialties

| | Practice Size (#MDs) | | | |
|---|---|---|---|---|
| | 1 | 2 - 4 | 5 - 9 | 10+ |
| Output per hour[a] | .94 | 1.01** | 1.05** | 1.06** |
| Hours per year | 2321 | 2388* | 2295 | 2321 |
| Output per year[a] | 2161 | 2394** | 2416** | 2474** |
| Office visits per hour | 2.73 | 3.11** | 3.12** | 2.97* |
| Office hours per year | 1406 | 1339** | 1180** | 1340 |
| Office visits per year | 3753 | 4185** | 4046 | 4402** |
| Number of Physicians | 1478 | 831 | 261 | 290 |

II. GP/FPs

| | Practice Size (# MDs) | | | |
|---|---|---|---|---|
| | 1 | 2 - 4 | 5 - 9 | 10+ |
| Output per hour[a] | .97 | .98 | 1.08 | 1.02 |
| Hours per year | 2336 | 2328 | 2334 | 2239 |
| Output per year[a] | 2234 | 2342 | 2480 | 2285 |
| Office visits per hour | 3.29 | 3.42 | 3.39 | 3.17 |
| Office hours per year | 1655 | 1611 | 1673 | 1650 |
| Office visits per year | 5280 | 5333 | 5547 | 5379 |
| Number of Physicians | 356 | 198 | 50 | 46 |

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*Significantly different from the value for solo practitioners at the 10 percent level of significance.

**Significantly different from the value for solo practitioners at the 5 percent level of significance.

[a] Output is measured by a time-based, multi-setting output index (see Section 4.2). Physician's visits in each of five settings are weighted by the mean number of hours per visit in that setting for the physician's specialty and then summed.

Source: HCFA-NORC 1984-85 Physician Survey.

specialties or for GP/FPs only (the results for GP/FPs are not statistically significant at the 10 percent level). The only exception is office visits per hour for GP/FPs in group sizes of ten or more. Their mean office visit intensity, 3.17 visits per hour, is less than that of solo GP/FPs, 3.29 visits per hour. However, this productivity difference is not statistically significant.

While group physicians are more productive than solos, small group (2-4 or 5-9 physicians) physicians are not consistently more productive than large group (10+) physicians. GP/FP multi-setting and office setting intensity and annual productivity are higher in groups of 5-9 than they are in large groups. Also, for combined specialties, office visits per hour are higher for small group than large group physicians. (3.11 and 3.12 versus 2.97). On the other hand, for combined specialties, large group physicians are generally more productive than small group physicians. They have the highest multi-setting output per hour and per year, and the greatest number of office visits per year.* Since none of the differences in mean productivity between small and large groups are statistically significant, these results should be interpreted cautiously.

To recapitulate, the inverted-U shaped hypothesis for the relationship between physician productivity and group size is partially supported by our data. For GP/FPs it is confirmed, although the results are not statistically significant. Productivity is highest for physicians in 5-9 physician groups and falls off for either smaller or larger group sizes. On the other hand, for combined specialties it is rejected, except perhaps for office visits per hour. Productivity increases roughly monotonically with group size. It

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*Mean office visits per year are higher for large group physicians than for physician groups of 2-4, in spite of lower mean visits per hour and identical mean hours worked. This is because of a stronger positive covariance between hours worked and visits per hour among large group physicians. This can be deduced from the mathematical relationship:

$$E(V/Y) = E\,[(V/H)\;.\;(H/Y)] = E(V/H)\;.\;E(H/Y) + \mathrm{Cov}(V/H,\ H/Y)$$

where "E" denotes the expectation operator and "Cov" denotes covariance.

does appear, however, that output levels drop off between the 5-9 and 10+ physician group sizes. Productivity may, therefore, turn down at some larger group size, and the inverted U hypothesis might be confirmed for a different set of group sizes. In any case, the relationship between group size and productivity cannot simply be extrapolated from GP/FPs to all specialties.

Our strongest and most consistent finding is that group physicians are more productive on average than solo practitioners. Differences in mean annual productivity are due mostly to differences in mean hourly productivity.** There are generally only minor differences between solo and group practitioners in mean medical or office hours worked, either for combined specialties of GP/FPs only.

## 5.6 Productivity In Alternative Health Plans

It is difficult to make strong predictions about how participation in an AHP will effect a physician's productivity (Luft, 1981). In part, this arises from the enormous diversity in organizational forms and financial arrangements in AHPs. Terms like Health Maintenance Organization (HMO), Independent Practice Association (IPA), and Preferred Provider Organization (PPO) are rather vague, imprecise appellations which mask much underlying variation. The precise financial incentives and organizational constraints faced by a physician cannot be inferred simply from whether he participated in an HMO, IPA, or PPO.

Even the stylized characteristics of AHPs have offsetting or unclear implications for productivity. Prepayment for comprehensive medical care is the essential characteristic of HMOs, including IPAs. Fixed payment independent of the use of services creates strong financial incentives for the HMO to limit utilization per enrollee. However, this incentive does not have any implications for physician productivity, which is a rate of output per physician time, not per enrollee. Fixed payment also creates an incentive for

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**And, possibly, to differences between solo and group physicians in the strength of the covariance between output per hour and hours worked per year. see footnote above.

efficient production of health services. Prepaid group practice (PGP) HMOs attempt to increase physician productivity and thereby lower costs through the realization of economies of scale in group practice and the substitution of allied health personnel for physician time. On the other hand, many PGP physicians are compensated on salary rather than fee for service. This reduces incentives to "create" visits, but it also reduces incentives for productivity and work effort. Moreover, the large multi-specialty group practices often associated with HMOs seem to exceed the optimal scale. Empirical studies have found small group practices to be the most productive (see Section 2.2).

These offsetting effects make it unclear whether to expect PGP physicians to be more or less productive than traditional fee-for-service physicians. Luft's (1981) synthesis of the empirical evidence indicates that physicians' annual productivity is similar in large fee-for-service and prepaid groups, which is in turn lower than productivity in small groups. The use of ancillary personnel is also similar in the two types of large groups. Thus, group size effects are more important than prepayment effects. On the other hand, there is some evidence that visit intensity is higher in prepaid groups, while work effort is lower (see Section 2.2).

There is even less reason to expect major productivity differences between physicians participating in IPAs and PPOs and traditional fee-for-service physicians. Most IPA or PPO physicians are, in fact, reimbursed on a fee-for-service basis (Goodman and Swartwout, 1984; Lissovoy et al., 1986). Moreover, IPA and PPO physicians work in their own offices serving both IPA or PPO and other patients. Thus, IPA and PPO physicians seem to be very similar to traditional physicians. IPAs and PPOs have sometimes been promoted as mechanisms to control utilization and costs, but their organizational structures are often very loose (Gabel and Ermann, 1985). Even if utilization review was stringent, it is not clear what implications this has for physician productivity.

Any influence of IPAs or PPOs on productivity probably arises from their demand side, rather than supply side, effects. IPAs and PPOs (and also PGP

HMOs) give enrollees incentives to use member physicians. Ceteris paribus, this increases the demand for the services of IPA or PPO physicians and should lead to higher work effort and productivity. On the other hand, if physicians join IPAs or PPOs because they face low demand in the first place, it is not clear that IPA/PPO physicians will face higher demand or be more productive than non-IPA/PPO physicians.

Our empirical tests of the effects of AHPs on productivity have some limitations. We calculate the means of six productivity and work effort variables--multi-setting output per hour and per year, total medical hours, office visits per hour and per year, and office hours per year--by participation in an AHP for both combined specialties and GP/FPs only. Participation/non-participation is a rather crude distinction since a physician may report participation in an IPA, PPO, or HMO even if none or only a small fraction of his practice income came from that source. For example, Goodman and Swartwout (1984) report that IPA patients generally account for less than 15 percent of an IPA-member physician's practice. In our calculations the productivity of each physician who reports participation in an AHP is weighted equally in computing the overall average for that plan, regardless of the extent of his involvement. Furthermore, the categories IPA, PPO, and HMO are not mutually exclusive. A physician may participate in more than one AHP. In that case his productivity will be included in the average for each plan in which he participated. Finally, in these descriptive results, nothing is held constant to isolate the effects of AHP participation from other factors.

Mean physician productivity by participation in an AHP is presented in Table 5-16. In the HCFA-NORC survey, "HMO" was defined as a "closed panel prepaid group practice" to distinguish it from IPAs. A physician is considered to have participated in an AHP if he participated in at least one IPA, PPO, or HMO. The sample for the analysis is the same as for the practice size analysis and is described in detail in Section 5.5. Certain specialties are excluded from the combined-specialty analysis. Hospital employees are excluded from both the combined-specialty and GP/FP analyses. However, physicians employed by a clinic or HMO or by another physician or a corporatin are included in the sample, together with physicians who are self-employed, partners, or part-owners.

Only physicians participating in IPAs have mean productivity which is statistically significantly different from the mean productivity of physicians who did not participate in any AHPs. IPA intensity, annual productivity, and work effort are higher than that of non-AHP physicians, both for all settings and the office setting, and for combined specialties and GP/FPs. A number of the differences are statistically significant. In magnitude, the differences between IPA and non-AHP physicians range from 2 to 15 percent. The largest percentage differences are in annual productivity, which is due to the combined effects of higher IPA intensity and work effort. For example, GP/FPs participating in IPAs provide, on average, 6,000 office visits per year, compared to an average of 5,217 for non-AHP physicians. This is a difference of 15 percent. It is not clear whether higher IPA productivity results from a causal influence of IPAs on productivity, such as a demand augmentation effect, or simply whether more productive physicians join IPAs.

The productivity and work effort of PPO and HMO physicians do not differ significantly from that of non-AHP physicians. GP/FPs participating in PPOs do provide, on average, about 5 percent more office visits per year than non-AHP GP/FPs (5501 versus 5217), but this difference is not statistically significant. In our data, HMO physicians exhibit neither the higher visit intensity nor the lower work effort which has been found previously (see Section 2.2). Our results are consistent, however, with Luft's general conclusion that "there is little difference in the productivity of HMOs" (1981, p. 164). Our finding of no differences for PPO and HMO physicians could be due to the fact that up to one-third of the physicians in our sample who reported participating in an AHP did not actually derive any income from that source. Hence, many physicians reporting participation were not actually very heavily involved in AHPs.

Overall, AHP physicians tend to be slightly more productive than non-AHP physicians. This is clearly due to IPA physicians rather than PPO or HMO physicians. None of the AHP/non-AHP differences are statistically significant at the 10 percent level, however.

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TABLE 5-16

MEAN PHYSICIAN PRODUCTIVITY BY PARTICIPATION IN ALTERNATIVE HEALTH PLANS, 1984.

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I. Combined Specialties

| | Participated in at least one: | | | | |
|---|---|---|---|---|---|
| | IPA | PPO | HMO[b] | AHP[c] | No AHP |
| Output per hour[a] | 1.00 | .98 | .99 | 1.00 | .98 |
| Hours per year | 2434** | 2364 | 2270 | 2335 | 2336 |
| Output per year[a] | 2416** | 2304 | 2248 | 2335 | 2262 |
| Office visits per hour | 3.18** | 2.91 | 2.89 | 3.01 | 2.91 |
| Office hours per year | 1461 | 1423 | 1399 | 1427 | 1423 |
| Office visits per year | 4368** | 4070 | 3969 | 4154 | 3983 |
| Number of Physicians | 349 | 332 | 466 | 867 | 1961 |

II. GP/FPs

| | Participated in at least one: | | | | |
|---|---|---|---|---|---|
| | IPA | PPO | HMO[b] | AHP[c] | No AHP |
| Output per hour[a] | 1.03 | .97 | .97 | .99 | .98 |
| Hours per year | 2390 | 2343 | 2334 | 2326 | 2309 |
| Output per year[a] | 2519 | 2302 | 2213 | 2296 | 2269 |
| Office visits per hour | 3.46 | 3.29 | 3.12 | 3.31 | 3.33 |
| Office hours per year | 1774* | 1669 | 1686 | 1712 | 1632 |
| Office visits per year | 6000* | 5501 | 5132 | 5504 | 5217 |
| Number of Physicians | 70 | 56 | 85 | 161 | 489 |

---

*Significantly different from the value for "No AHP" at the 10 percent level of significance.

**Significantly different from the value for "No AHP" at the 5 percent level of significance.

[a] Output is measured by a time-based, multi-setting output index (see Section 4.2). Physician's visits in each of five settings are weighted by the mean nnumber of hours per visit in that setting for the physician's specialty and then summed.

[b] HMO is defined here as a "closed panel prepaid group practice."

[c] AHP is defined as an IPA, PPO, or HMO.

Source: HCFA-NORC 1984-85 Physician Survey.

# 6.0 MULTIVARIATE ANALYSIS

The descriptive study in Chapter 5 revealed simple two-way correlations between productivity measures and factors influencing productivity. We rely on multivariate analysis in this chapter to identify the statistically significant effects of these variables on productivity, holding constant confounding factors. Following the lead of Reinhardt (1975) and Lorant and Kimbell (1976), we estimate a single equation production function, measuring inputs directly, to describe the technical relationship between physician output and inputs. To explain work effort decisions, we also estimate a reduced-form labor supply equation based on the theoretical model described in Chapter 3.

Using newly-collected 1984-85 HCFA-NORC data, we were able to update Reinhardt's production function findings as well as examine some additional factors affecting the production function. Similarly, these data allowed us to examine the effects of new practice arrangements on work effort (e.g. the effects of employment and alternative health plan participation). The main drawback to using the 1984-85 HCFA-NORC data was that its limited sample size forced us to combine four primary care specialties (general and family practice, internal medicine, and pediatrics) for all the multivariate analyses. Also, lack of data on physician inputs for employed physicians restricted the production function analysis to self-employed physicians. However, subsetting to self-employed physicians makes our study more comparable with previous work.

## 6.1 Empirical Specification

### 6.1.1 Functional Form

As discussed in Chapter 3, economists consider physician output to be a function of physician inputs and other labor and capital inputs. Exogenous factors such as practice size can also affect output levels by shifting the function. Most production functions are estimated using a multiplicative specification such as a Cobb-Douglas function. However, in estimating physician output, a simple Cobb-Douglas production function is inappropriate because it assumes: (1) positive rates of all inputs at positive rates of output; (2) diminishing marginal productivity throughout the entire range of inputs; and (3) unitary elasticity of substitution among inputs. Because physicians are able to produce visits without certain inputs and may not exhibit diminishing marginal productivity and constant elasticity of substitution over various output and input levels, modified versions of the Cobb-Douglas production function are generally used (see Reinhardt, 1975 and Lorant and Kimball, 1976). Reinhardt specifies a modified Cobb-Douglas functional form that does not impose the restrictions listed above:

$$Q = A \prod_{j}^{m} \left[ X_j^{a_j} e^{b_j X_j} \right] e^{g(X,Y;c,d)} \qquad (6.1)$$

where Q represents physician output, vector X comprises essential inputs, and vector Y comprises "nonessential" inputs (i.e., those not necessary for positive rates of output). To permit both increasing and decreasing marginal productivity of the nonessential inputs, function g(X,Y;c,d) can also be specified nonlinearly. Including cross-products between essential and nonessential inputs in function g allows the maximum marginal products of the nonessential inputs to vary as a function of essential inputs. As long as g(X,Y;c,d) is specified such that it is linear in parameters c and d, the entire function can be estimated by linear regression techniques upon conversion into logs.

While this specification imposes very few restrictions on the parameters, it does pose problems of multicollinearity in estimation. Consequently, we made some simplifying assumptions in adopting this functional form. For example, although the most essential input (physician hours) was allowed to demonstrate both increasing and decreasing marginal productivity in our specification, other essential inputs were restricted to showing either one or the other. Secondly, cross products between essential and nonessential inputs were not included so that the maximum marginal products of the nonessential labor inputs do not necessarily vary as a function of the essential inputs. Finally, we used a "modified" polynomial for our nonessential labor inputs by combining their squared terms into one term. Thus, our specification for estimation is as follows:

$$Q = A \prod_{j}^{3} \left[ X_j^{a_j} e^{b_1 X_1} \right] e^{g(Y;c,d)} \qquad (6.2)$$

where g(Y;c,d) is specified as:

$$g(Y;c,d) = \sum_{j}^{4} c_j Y_j - d_1\left[\sum_{j}^{3} Y_j\right]^2 - d_2[Y_4]^2 \qquad (6.3)$$

and where $X_1$ is physician hours, $X_2$ and $X_3$ are other essential inputs (space and supplies), $Y_1$, $Y_2$, and $Y_3$ are nonessential labor inputs (administrative aides, nurses, and technicians), and $Y_4$ are nonessential equipment inputs.

For the reduced-form work effort regressions, there were fewer a priori expectations for a functional form. Consequently, we used a double-log form which allowed all the continuous variables to be nonlinearly related to hours and facilitated interpretation of the results.

### 6.1.2 Measurement of Production Function Variables

#### Dependent Variables

To measure physician output in the production function, we used both physician visits and gross revenues. As noted in Chapters 3 and 4, raw visits imperfectly measure physician output; although they measure quantity of physician services provided, they do not capture the quality component of services. Thus, physicians seeing fewer patients but providing more services to their patients appear less productive when in fact they may be more productive, say, in improving health status. To the extent that physician fees capture the true value of the physician service, gross revenues may provide a better measure of physician services. Unfortunately, because of price distortions in this sector, gross revenue is also a flawed measure of physician output. However, comparison of the production function results using these alternative measures can help to identify and/or rule out erroneous findings based on such measurement errors.

Both total visit and office visit production functions were estimated. If physicians' other inputs were unrelated to their productivity in other settings, then office visits would suffice as a measure of output. However, since "office-related" inputs probably contribute to physician output in other settings as well, e.g., secretaries arrange hospital visits, then physicians spending more time in other settings could appear less productive when only office visits are counted as output. For comparison, we also estimate a total visit regression, aggregating visits and hours across all settings and weighting visits with the time-based index discussed in Chapter 4.

All three measures of physician productivity were measured per physician on an annual basis. (See Table 6-1 for variable definitions.) Because visits were measured on a weekly basis, we had to multiply weekly visits by the number of weeks worked to obtain an annual measure. Thus, the annual measure is subject to measurement error based on week-to-week variation in the number of patients seen.

The gross revenue measure was also adjusted for geographic cost-of-living differences in an effort to limit price distortions in output value. The geographic cost-of-living (COL) index was created at the county level by following the general methodology developed by the Institute of Medicine (1976). First, a predicitive budget equation was estimated based on Bureau of Labor Statistics budget data for 23 metropolitan areas. Using regression coefficients from the estimated equation, budgets were then imputed for each of the 3,080 counties of the United States. In the final step, county budget estimates were deflated by an average budget estimate yielding a county-specific COL index.

### Independent Variables

Ideally, the inputs used to produce physician services would be measured as a flow. The number of physician hours worked, available from the HCFA-NORC data, is a fairly good measure of the contribution of this input to the provision of services. However, data available for the other two essential inputs, office space and medical supplies, is limited to the annual costs of these inputs. To the extent that costs reflect the use of inputs, these measures can be considered adequate proxies of input flows. While annual costs of medical supplies most likely reflect the use of these inputs, it is not so clear that office space costs reflect the use of an office. Since office space costs are presumably more fixed than, say, medical supplies, physicians cannot easily reduce them if lower patient demand results in unused space. In addition, the cost of office space is measured by rental and/or depreciation expenses, neither of which may perfectly reflect the size or quality of the input. Presumably, deflating such costs by an area-specific COL should limit this problem somewhat. Although equipment was considered a nonessential input, it was measured the same way as office space and is thus subject to the same types of measurement problems.

TABLE 6-1

VARIABLE DEFINITIONS

TOTVIS* = Physician's annual visits in all settings
OFFVIS* = Physician's annual visits in the office setting
LNGROSSREV = Real annual gross revenues per MD, logged
OFFHRS* = Physician's annual patient care office hours
LNSPACE = Real, annual office space depreciation and rental costs per MD, logged
LNMSUPL = Real annual medical supply costs per MD, logged
EQUIP = Real annual medical equipment costs per MD
SQEQUIP = (EQUIP)$^{2}$
ADMIN = Number of adminstrative aides employed per MD
NP_NURS = Number of nurses, nurse practioners, and physician assistants per MD
TECH = Number of technicians per MD
SQALL = (ADMIN + NP_NURS + TECH)$^{2}$
AGE = Physician age
SQAGE = (AGE)$^{2}$
FEMALE = Dummy variable for female physicians
MARRIED = Dummy variable for married MDs
YGT10K = Dummy variable for MDs with outside income greater than $10,000
BOARD = Dummy variable for board certified MDs
FMG = Dummy variable for foreign medical graduates
WHITE = Dummy variable for white MDs
FP = Dummy variable for family practitioners
INT = Dummy variable for internists
PED = Dummy variable for pediatricians
MD = Number of physicians in practice
SQMD = (MD)$^{2}$
MSG = Dummy variable for physicians in multi-specialty groups
SHARY = Dummy variable for MDs in groups sharing income equally
EMP = Dummy variable for employed MDs
HMO = Dummy variable for physicians participating in an HMO
PPO = Dummy variable for physicians participating in a PPO
IPA = Dummy variable for physicians participating in an IPA
PCMPSMSA* = Primary care physicians (GPs, FPs, INTs, and PEDs) per 100,000 pop.
DPCINC* = Real per capita income of physician's county
NE = Dummy variable for physicians in the Northeast
SO = Dummy variable for physicians in the South
WS = Dummy variable for physicians in the West
PCTHV = Percent inpatient visits
PCTOPDV = Outpatient and emergency room visits
PCTSURP = Percent patients operated on
PCTNH = Percent nursing home visits
PCTVOS* = Percent visits in all settings but office

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*For some analyses these variable names are preceded by "L" to signify that they were logged.

Other nonessential inputs include non-physician labor such as secretarial or other administrative personnel (ADMIN); nurses, nurse practitioners or physician assistants (NP-NURS); and technicians (TECH).

Ideally, like physician input, these inputs would also be measured by hours of service provided. Unfortunately, the data were not available in this form. Instead, simple counts of non-physician personnel employed by the physician were used. Unfortunately, we could not even obtain the number of full-time equivalents since no information was provided on how many of these aides worked part-time. In addition, because only about one-tenth of our sample employed nurse practitioners or physician assistants, this group was combined with other nurses in the variable, NP-NURS (see Table 6-1).

In addition to the inputs, a number of other exogenous variables thought to shift the production function were included to hold constant these factors. For example, group size (measured in full-time equivalents) was included to account for any economies or diseconomies of scale. Participation in a multispecialty group practice (MSG) was also controlled for. Dummy variables for participation in alternative health plans (e.g. HMOs, IPAs, and PPOs) were also included to test for the effects of organizational differences on productivity. Unfortunately, it is not clear exactly how these plans differ from one another since many are still in developmental stages. In addition, the dummy variables used do not capture the degree of physician participation in these plans. Finally, the mix of physician services across settings was included to hold constant differences in output complexity. If more visits in other settings indicate a more complex casemix, we would expect them to be positively correlated with gross revenues, but negatively associated with visits.

Physician age and sex were also held constant to account for differences in practice styles based on these physician characteristics. For example, female physicians tend to provide longer (and thus fewer) visits while older, more experienced physicians may produce more visits. Because four primary care specialties were combined for the analysis, specialty dummies were also included to hold constant specialty effects that might shift the production function. Ideally, interactions between specialty dummies and inputs would also be included, but multicollinearity precluded this refinement.

Finally, demand characteristics can also obscure the technical relationship between inputs and physician output. For example, physicians in low demand areas may spend about the same amount of time in the office as physicians in high demand areas, seeing fewer patients and having more downtime, or physicians in wealthier areas may face a higher demand for longer visits, making them appear less productive. To hold these effects constant, we included variables measuring physician scarcity and the wealth of the community (PCMDSMSA and DPCINC).

### 6.1.3 Measurement of Variables for Reduced-Form Work Effort Regressions

#### Dependent Variables

Two dependent variables were used for the work effort regressions: annual patient care office hours, OFFHRS, and annual patient care total hours, TOTHRS (see Table 6-1). As before, annual hours were obtained by multiplying hours worked in the past week by the number of weeks worked per year.

#### Independent Variables

Three sets of variables were included in the reduced-form work effort regressions: physician characteristics, practice characteristics, and demand characteristics. Included variables are intended to proxy the exogenous factors influencing physicians work decisions as specified in Chapter 3. Some variables like age and sex may reflect both physician preferences and practice effects on work effort.

Variables describing physician characteristics proxy physician preferences for leisure vs. income. Assuming diminishing marginal utility of income, physicians with more unearned income should prefer more leisure and exhibit fewer working hours. To test this hypothesis, we included a dummy variable for physicians with outside incomes greater than $10,000 (YGT10K). For sociological reasons, women are likely to place more value on non-market activities so that we expect a negative sign on our sex dummy (FEMALE). Older physicians near retirement are also expected to have a higher preference for leisure and should show lower work effort. However, very young physicians may exhibit fewer work hours because their practices are not yet established. To account for both these effects, physician age was entered into the regressions in polynomial form (AGE and $\mathrm{AGE}^2$).

Marriage status can either increase work effort if it proxies greater financial responsibilities due to the presence of a family, or it can decrease work effort if it proxies the presence of a second income. Given that the presence of outside income is already held constant in our regressions, we expect to find married physicians working longer hours. Differences in ethnic backgrounds may also lead to different income-leisure preferences. Such differences may be picked up by the dichotomous race (WHITE) or foreign medical graduate (FMG) dummies included in the regression. However, demand effects may also confound the relationship between ethnicity and work effort. If non-white physicians or FMGs are perceived to produce lower quality visits, they may face lower demand and consequently work fewer hours. Similarly, if board-certified physicians are perceived to produce higher quality services, they should face higher demand and work more hours.

Practice characteristics are also expected to affect work effort. For example, employed physicians presumably have weaker incentives to work overtime, so that we expect a negative sign on EMP. Group practitioners benefiting from economies of scale may also work fewer hours on average. Based on evidence that large groups may be subject to diseconomies of scale, we included the group size variable (MD) as a polynomial as well. Physicians working in groups sharing income equally presumable have fewer financial incentives to work overtime, so we would expect negative coefficient on the dummy variable for this group (SHARY).

Different incentives provided by the financial organization of alternative health plans may also affect physician work effort. Straight salary should provide the weakest incentive for working overtime while fee-for-service arrangements should provide the strongest. To the extent that HMOs rely more on capitated arrangements while PPOs and especially IPAs rely more on fee-for-service arrangements, we would expect HMO participants to exhibit the lowest work effort relative to PPO and IPA participants. However, demand considerations may confound these results if physicians with low private demand tend to participate more in such organizations.

Finally, physicians seeing more patients in non-office settings may appear to work less in the office. Thus, we also included the percent of visits in other settings in our office hours regressions.

To proxy demand effects on work effort, a number of population characteristics were included in the regressions. Physician availability is measured by primary care physicians per SMSA or rural county population (PCMDSMSA) and is expected to be negatively correlated with work effort. To the extent that real per capita income proxies demand for more physician services, it should be positively correlated with work effort. Regional dummies were included to measure demand effects not already captured by the other population characteristics.

## 6.2 Estimation Methods

All the HCFA-NORC data used for the multivariate analysis came from the 1984-85 survey. As noted earlier, a limited number of observations for any one specialty required pooling four primary care specialties for all analyses. Combining these specialties yielded an initial sample size of 1,337. From this sample 68 were deleted from both work effort and production function analyses because of missing or inaccurately reported productivity data. (Physicians reporting visits longer than 2 and 1/2 hours on average and shorter than six minutes on average were assumed to have reported inaccurately.) Since only self-employed physicians reported practice inputs 251 employed physicians were automatically excluded from the production function regressions. Another 354 observations dropped out because of missing input data. Not only was much of the data missing, but the input data (particularly the cost data) were not always reported accurately Outlier thresholds were used to delete such misreported input data. The most stringent cut-off was applied to physicians with office space costs per visit of less than $.20 or more than $9.00, eliminating approximately 109 physicians from the sample. Another 40 physicians reporting annual, per-physician medical supply costs of more than $10,000 or less than $128 were also excluded. Finally, six physicians reporting equipment costs of more than $67,000 and 2 physicians reporting 19 secretaries and 26 nurses per physician, respectively, were eliminated from the analysis.

Ordinary least squares (OLS) was the estimation technique used for all the multivariate analysis. However, errors in measurement of annual output (visits per year) make OLS estimates of the production function subject to bias from regression fallacy. In a study of practice cost functions, Ernst and Schwartz (1974) argued that similar output measurement problems produced underestimates of marginal and average costs and overestimates of true optimal scale. Error in our annual output measure due to weekly variation in the number of patients seen may also bias the coefficients on our input variables downward (see Section 6.1.2 about the measurement of annual visits).

While office visits and hours are measured at the physician level, other input variables and practice are measured at the practice level. To correct for this measurement error, we standardized non-physician inputs and gross revenues by the number of full-time-equivalent physicians in the practice.

While this correction should reduce the bias in the estimated coefficients, it is not a perfect adjustment, so we may still observe some downward bias in our input coefficients. As a result of standardizing practice level variables, our group size variable will be negatively correlated with gross revenues and non-physician inputs. These correlations could introduce multicollinearity into the visit equations and reduce the group size effect in the gross revenue equation.

## 6.3 Multivariate Results

### 6.3.1 Office Setting Production Fuctions

Table 6-2 shows the effects of practice inputs on physician output holding constant various physician, practice and demand characteristics. Holding none of these effects constant in equation 1, the input coefficients show all the expected signs, although not all of them are statistically significant at the 90% confidence level (i.e., have "t" statistics of more than 1.65). As expected, physician hours was the most important determinant of physician output with a .71 elasticity of output evaluated at the mean of 1,660 annual hours (.71 = .865-(.000092)(1660)). This is consistent with Reinhardt's estimated elasticity of .67 for GP's (see Reinhardt, 1975). The number of aides employed, particularly nurses and administrative aides, is also significantly associated with physician productivity. Taken as a group, the average output elasticity of aides is much less than that of physician hours, however, only .19 (= (.077)(2.94)-(.004)(864)). This aide elasticity of output is also much lower than the one estimated by Reinhardt for GPs (.36). Our estimated coefficient may be biased downward because the aides measures do not take into account part-time employees and are consequently overestimates of these inputs.

Although the use of medical supplies is significantly related to output, its output elasticity is only .07 (see Table 6-2). Since the raw office visit measure of output does not account for differences in output quality and intensity, it is likely that the effects of this input are underestimated. In fact, using the gross revenue measure of output, which presumably captures quality effects, results in a much higher medical supply elasticity of output (see Section 6.3.2). Other non-labor supplies (office space and equipment) do not appear to be significantly related to output, showing "t" statistics of less than one.

TABLE 6-2

ESTIMATED PRODUCTION FUNCTIONS: OFFICE VISITS

| Variables | Means | Eq. 1 | | Eq. 2 | | Eq. 3 | | Eq. 4 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Coeff. | "t" | Coeff. | "t" | Coeff. | "t" | Coeff. | "t" |
| INTERCEPT | 1.00 | 1.200 | 1.05 | 1.516 | 1.37 | 1.508 | 1.36 | 1.932 | 1.78 |
| LNOFFHRS | 7.35 | 0.865 | 4.83 | 0.808 | 4.77 | 0.791 | 4.65 | 0.805 | 4.90 |
| OFFHRS | $1.66\times10^{3}$ | $-9.2\times10^{-5}$ | 0.76 | $-1.5\times10^{-4}$ | 1.27 | $-1.4\times10^{-4}$ | 1.19 | $-2.1\times10^{-4}$ | 1.85 |
| LNSPACE | 8.78 | 0.021 | 0.68 | 0.016 | 0.53 | 0.027 | 0.89 | 0.054 | 1.81 |
| LNMSUPL | 8.67 | 0.069 | 3.45 | 0.042 | 2.24 | 0.041 | 2.15 | 0.043 | 2.33 |
| EQUIP | $3.5\times10^{3}$ | $6.0\times10^{-6}$ | 0.77 | $7.1\times10^{-6}$ | 0.97 | $5.4\times10^{-6}$ | 0.72 | $5.7\times10^{-6}$ | 0.80 |
| SQEQUIP | $38.77\times10^{6}$ | $-1.64\times10^{-10}$ | 0.74 | $-1.8\times10^{-10}$ | 0.90 | $-1.3\times10^{-10}$ | 0.65 | $-8.6\times10^{-11}$ | 0.44 |
| ADMIN | 1.66 | 0.079 | 3.13 | 0.070 | 2.89 | 0.073 | 2.99 | 0.048 | 2.04 |
| NP_NURS | 0.91 | 0.096 | 3.76 | 0.074 | 3.05 | 0.074 | 2.99 | 0.065 | 2.74 |
| TECH | 0.37 | 0.056 | 1.48 | 0.052 | 1.44 | 0.040 | 1.11 | 0.033 | 0.94 |
| SQALL | 11.32 | -0.004 | 2.58 | -0.003 | 2.05 | -0.003 | 2.11 | -0.003 | 1.95 |
| AGE1 | 49.17 | | | 0.032 | 2.24 | 0.032 | 2.24 | 0.028 | 2.06 |
| SQAGE1 | $2.56\times10^{3}$ | | | $-3.5\times10^{-4}$ | 2.56 | $-3.5\times10^{-4}$ | 2.54 | $-3.1\times10^{-4}$ | 2.35 |
| FEMALE | 0.07 | | | -0.259 | 3.14 | -0.238 | 2.81 | -0.274 | 3.36 |
| FP | 0.36 | | | -0.093 | 1.49 | -0.103 | 1.64 | -0.079 | 1.33 |
| INT | 0.33 | | | -0.386 | 5.99 | -0.407 | 6.24 | -0.356 | 5.22 |
| PED | 0.17 | | | 0.010 | 0.14 | -0.004 | 0.05 | -0.063 | 0.87 |
| MD | 2.82 | | | | | 0.020 | 2.11 | 0.019 | 2.08 |
| SQMD | 42.75 | | | | | $-2.2\times10^{-4}$ | 1.57 | $-2.1\times10^{-4}$ | 1.56 |
| MSG | 0.10 | | | | | -0.044 | 0.54 | -0.026 | 0.33 |
| HMO | 0.11 | | | | | -0.013 | 0.20 | 0.029 | 0.46 |
| PPO | 0.09 | | | | | 0.004 | 0.13 | 0.066 | 0.94 |
| IPA | 0.13 | | | | | -0.006 | 0.10 | 0.036 | 0.60 |
| PCTHV | 0.19 | | | | | | | -0.460 | 3.35 |
| PCTOPOV | 0.04 | | | | | | | -0.791 | 2.89 |
| PCTSURP | 0.01 | | | | | | | -2.463 | 1.38 |
| PCTNH | 0.03 | | | | | | | -1.003 | 3.97 |
| PCMDSMSA | 67.19 | | | | | | | -0.004 | 1.62 |
| SQPCMDMSA | $5.24\times10^{3}$ | | | | | | | $1.2\times10^{-5}$ | 1.05 |
| DPCINC | $8.81\times10^{3}$ | | | | | | | $-2.4\times10^{-5}$ | 1.69 |
| NE | 0.23 | | | | | | | 0.076 | 1.30 |
| SO | 0.31 | | | | | | | -0.003 | 0.06 |
| WS | 0.22 | | | | | | | -0.148 | 2.38 |
| $R^2$ | | .36 | | .43 | | .43 | | .50 | |
| F/DOF | | 28/485 | | 25/479 | | 18/473 | | 16/463 | |

Equation 2 controls for physician characteristics proxying different practice "styles" (e.g., age, sex and specialty). Holding constant these factors improves the explanatory power of the equation as can be seen by the increase in the adjusted $R^2$ from .36 in equation 1 to .43 in equation 2. As expected, productivity increases with age, at least until the physician is 45 years old. Older physicians may be spending more time with physicians for two reasons. First, because of their additional experience, they may see patients with more complex, time-consuming problems. Secondly, they may simply have different practice styles than younger physicians. Internists are probably also seeing an estimated 39% fewer visits per year for the former reason, while female physicians are presumably seeing 26% fewer for the latter reason.

Somewhat surprisingly, practice characteristics (with the exception of group size) show little productivity differences once inputs are held constant (see equation 3). The group elasticity of output is approximately .02 evaluated at the solo practice level, .04 at a group size of two and .09 at a group size of five. These results suggest that moving from a solo practice to a group size of two increases annual productivity by about 2%. Increasing practice size from two to five increases productivity 6% while doubling the number of physicians from five to ten increases productivity by 9%. These results are in contrast to earlier studies suggesting that productivity decreases after some optimal group size of about five physicians (see Chapter 2). Our estimates suggest that productivity continues to increase with group size up to a group size of 44.

Although holding constant practice characteristics failed to increase the explanatory power of the regression, holding constant demand characteristics and visit mix in non-office setting increased the adjusted $R^2$ from .43 to .50 (see equation 4). All four measures of physician activity in other settings are negative and two are significant at the 99% confidence level. Since office hours controls for the effects of physician input on office output, these variables are interpreted as casemix proxies. Physicians seeing more patients in other settings, particularly in the hospital setting, presumably have sicker patients requiring longer office visits. As a result, every one percent increase in the proportion of hospital and surgeries visits decreases office productivity by .08 and .02 percent respectively.

Holding constant the number of primary care physicians per capita in the physicians' SMSA or county should account for downtime in the office resulting from insufficient demand. Indeed, .2 percent fewer annual office visits are reported for every 1 percent increase in physician availability (in areas with average physician availability).

With PCMDSMSA holding constant demand effects, fewer annual office visits in wealthier areas (note the positive coefficient on DPCINC) are presumably due to a higher demand for longer visits. Finally, physicians in the West see significantly fewer patients annually than physicians in other regions, ceteris paribus. Western physicians may see more serious cases in the office (requiring longer visits) because of shorter hospital stays.

In addition to explaining more of the variance in annual office visits, holding constant visit length and demand factors affects the coefficients on some of the input variables. For example, the output elasticity of office space increases to .05 (from .03 in equation 3), becoming statistically significant. Most likely, physicians with high office space costs are also located in wealthier areas where patients demand longer visits. Thus, holding constant per capita income and region in equation 4 eliminates some of the downward bias in the coefficient for office space costs. By contrast, a negative correlation between per capita income and the number of administrative aides resulted in a lower coefficient on ADMIN when holding constant wealth effects.

With the exception of office space, the output elasticities of all the inputs in the fully-specified equation are slightly lower than those calculated for equation 1. In particular, the physician input elasticiticity of output decreased from .71 to .46 from equation 1 to equation 4, most likely because variables such as specialty, age and hospital setting activity were not held constant in equation 1. Older physicians and internists tend to work fewer office hours and also produce fewer office visits so that excluding these physician characteristics biases the office hours coefficient upwards (i.e. makes it less negative). Similarly, physicians seeing more patients in the hospital both work fewer office hours and see fewer patients in the office, so that holding constant visit mix decreased the office hour coefficient and the output elasticity for physician hours.

### 6.3.2 Comparing Visit and Gross Revenue Production Functions

Estimating a total visit production function (using the time-based index described in Chapter 4 to aggregate visits across settings) yields results remarkably similar to the office visit production function (see Table 6-3). The output elasticity of total physician hours (.67) is larger than the .46 elasticity estimate in the fully-specified office visit equation, while output elasticities for medical supplies and office space costs are nearly identical in the office and total visit equations. However, the output elasticity for aides is slightly smaller in the total visit equation, particularly with respect to nurses.

As expected, the proportion of visits provided in the hospital setting is positively correlated with total annual productivity, reflecting the fact that hospital visits are shorter than office visits. Controlling for visit content in the gross revenue equations eliminates this effect.

Differences between "raw visit" production functions and the gross revenue production function are pronounced. For example, the output elasticity on physician hours falls to .24 (from .46 and .67 in the office and total visit equations), while the output elasticities for office space and medical supply inputs more than double. Aides elasticity of output is also more than twice as high in the gross revenue equation than in the visit equations mostly because of the increased contribution of technicians to output. The effects of equipment costs on productivity remain insignificant however. Movement in the input elasticities of physician output between visit and revenue equations is most likely related to measurement error introduced by measuring costs on annual basis at the practice level and physician hours and visits on a weekly basis at the physician level. In the visit equations, coefficients on inputs measured by annual costs are biased downward because of measurement error, while in the gross revenue equation, the coefficient on physician hours is biased downward.

Using the gross revenue measure, physician productivity peaks at an older age (53) as opposed to the age of 47 implied by the total visit estimates. This finding is not surprising given that the quality of physician output is expected to increase with age. In addition, productivity differences between male and female physicians essentially disappear in the gross revenue equation, presumably because women providing fewer visits are providing higher quality, or more intensive visits. For similar reasons, specialty differences also disappear on a gross revenue basis.

TABLE 6-3

ESTIMATED PRODUCTION FUNCTIONS: OFFICE VISITS, TOTAL VISITS, AND GROSS REVENUES

| Variables | Office Visits | | | Total Visits | | | Gross Revenues | | |
|---|---|---|---|---|---|---|---|---|---|
| | Means | Coeff. | "t" | Means | Coeff. | "t" | Means | Coeff. | "t" |
| INTERCEPT | 1.0 | 1.932 | 1.78 | 1.00 | $5.1\times10^{-4}$ | 0.00 | 1.00 | 3.886 | 2.25 |
| LNOFFHRS | 7.35 | 0.805 | 4.90 | -- | -- | -- | -- | -- | -- |
| OFFHRS | $1.66\times10^{3}$ | $-2.1\times10^{-4}$ | 1.85 | -- | -- | -- | -- | -- | -- |
| LNTOTHRS | -- | -- | -- | 7.76 | 0.860 | 5.30 | 7.75 | 0.507 | 2.07 |
| TOTHRS | -- | -- | -- | $2.47\times10^{3}$ | $-7.8\times10^{-5}$ | 1.07 | $2.45\times10^{3}$ | $-1.1\times10^{-4}$ | 1.03 |
| LNSPACE | 8.78 | 0.054 | 1.81 | 8.78 | 0.057 | 2.05 | 8.78 | 0.137 | 3.14 |
| LNMSUPL | 8.67 | 0.043 | 2.33 | 8.67 | 0.036 | 2.11 | 8.67 | 0.106 | 3.95 |
| EQUIP | $3.5\times10^{3}$ | $5.7\times10^{-6}$ | 0.80 | $3.05\times10^{3}$ | $1.0\times10^{-6}$ | 0.15 | $2.98\times10^{3}$ | $1.6\times10^{-6}$ | 0.16 |
| SQEQUIP | $38.77\times10^{6}$ | $-8.6\times10^{-11}$ | 0.44 | $38.77\times10^{6}$ | $3.8\times10^{-11}$ | 0.21 | $36.68\times10^{6}$ | $-8.5\times10^{-11}$ | 0.30 |
| ADMIN | 1.66 | 0.048 | 2.04 | 1.67 | 0.046 | 2.10 | 1.66 | 0.084 | 2.53 |
| NP_NURS | 0.91 | 0.065 | 2.74 | 0.91 | 0.046 | 2.06 | 0.89 | 0.051 | 1.49 |
| TECH | 0.37 | 0.032 | 0.94 | 0.37 | 0.036 | 1.14 | 0.38 | 0.148 | 3.06 |
| SQALL | 11.32 | -0.003 | 1.95 | 11.32 | -0.002 | 1.81 | 11.17 | $7.2\times10^{-4}$ | 0.35 |
| AGE1 | 49.17 | 0.028 | 2.06 | 49.17 | 0.027 | 2.13 | 49.12 | 0.083 | 4.25 |
| SQAGE1 | $2.56\times10^{3}$ | $-3.1\times10^{-4}$ | 2.35 | $2.56\times10^{3}$ | $-2.9\times10^{-4}$ | 2.37 | $2.56\times10^{3}$ | $-7.9\times10^{-4}$ | 4.20 |
| FEMALE | 0.07 | -0.274 | 3.36 | 0.07 | -0.243 | 3.21 | 0.07 | -0.030 | 0.26 |
| FP | 0.36 | -0.079 | 1.33 | 0.36 | -0.071 | 1.26 | 0.36 | 0.017 | 0.19 |
| INT | 0.33 | -0.356 | 5.22 | 0.33 | -0.133 | 2.09 | 0.33 | 0.016 | 0.16 |
| PEO | 0.17 | -0.063 | 0.87 | 0.17 | -0.015 | 0.22 | 0.17 | $-1.5\times10^{-4}$ | 0.00 |
| MD | 2.82 | 0.019 | 2.08 | 2.82 | 0.014 | 1.66 | 2.41 | 0.025 | 1.00 |
| SQMO | 42.75 | $-2.1\times10^{-4}$ | 1.56 | 42.75 | $-1.2\times10^{-4}$ | 0.98 | 15.81 | -0.001 | 0.93 |
| MSG | 0.10 | -0.026 | 0.33 | 0.10 | -0.010 | 0.14 | 0.10 | -0.105 | 0.96 |
| HMO | 0.11 | 0.029 | 0.46 | 0.11 | 0.042 | 0.71 | 0.10 | 0.020 | 0.22 |
| PPO | 0.09 | 0.066 | 0.94 | 0.09 | 0.075 | 1.15 | 0.09 | -0.027 | 0.27 |
| IPA | 0.13 | 0.036 | 0.60 | 0.13 | 0.044 | 0.80 | 0.13 | -0.099 | 1.17 |
| PCTHV | 0.19 | -0.460 | 3.35 | 0.19 | 0.504 | 3.97 | 0.19 | 0.320 | 1.61 |
| PCTOPOV | 0.04 | -0.791 | 2.89 | 0.04 | 0.531 | 2.08 | 0.04 | -0.408 | 1.02 |
| PCTSURP | 0.01 | -2.463 | 1.38 | .01 | 0.077 | 0.05 | 0.01 | 1.360 | 0.55 |
| PCTNH | 0.03 | -1.003 | 3.97 | .03 | 0.202 | 0.87 | 0.04 | 0.030 | 0.09 |
| PCMDMSA | 67.19 | -0.004 | 1.62 | 67.20 | -0.002 | 1.11 | 66.69 | -0.009 | 2.22 |
| SQPCOMSA | $5.24\times10^{3}$ | $1.2\times10^{-5}$ | 1.05 | $5.24\times10^{3}$ | $7.1\times10^{-6}$ | 0.65 | $5.13\times10^{3}$ | $3.9\times10^{-5}$ | 1.62 |
| OPCINC | $8.81\times10^{3}$ | $-2.4\times10^{-5}$ | 1.69 | $8.81\times10^{3}$ | $-2.9\times10^{-5}$ | 2.15 | $8.81\times10^{3}$ | $2.5\times10^{-6}$ | 0.12 |
| NE | 0.23 | 0.076 | 1.30 | 0.23 | 0.070 | 1.31 | 0.22 | -0.071 | 0.84 |
| SO | 0.31 | -0.003 | 0.06 | 0.31 | 0.024 | 0.50 | 0.31 | -0.094 | 1.25 |
| WS | 0.22 | -0.148 | 2.38 | 0.22 | -0.135 | 2.35 | 0.22 | 0.041 | 0.46 |
| $R^2$ | | .50 | | | .45 | | | .27 | |
| F/DOF | | 16/463 | | | 14/463 | | | 6/432 | |

Physicians in group practice do not appear more productive on a gross revenue basis. However, the insignificant group effect may be the result of measurement error in the dependent variable (see Section 4.3).

As expected, the productivity effects of variables proxying demand for higher quality or more intensive visits are not significant in the gross revenue equation. For example, real per capita income is no longer negatively related to productivity and western physicians appear no less productive than physicians in other regions. However, greater physician availability is significantly associated with lower productivity, suggesting that increased downtime from competitive pressures does decrease productivity.

### 6.3.3 Office-Setting Work Effort Functions

Table 6-4 shows reduced-form equations for physician office work effort as a function of physician, practice and demand characteristics. Examining the effects of physician characteristics without holding constant practice and demand factors, we find that while most variables show the expected sign, only physician age, having an outside income, and specialty effects, are statistically significant (see equation 1). The coefficients on AGE and SQAGE imply that physicians' work effort increases with age until they are about 48, after which it decreases. Physicians with outside incomes work about 7.6 fewer office hours annually. The estimated 7.7 percent fewer hours worked by females is nearly significant. Internists work 14 percent fewer office hours than GPs, probably because they spend more time in other settings. Pediatricians, on the other hand spend more time in the office setting.

The coefficients on physician characteristics change very little holding constant practice characteristics (see equation 2). Although some of the practice characteristics are significantly related to work effort (e.g. employee status) the explanatory power does not increase when controlling for these factors. Employees reported working 9.5 percent fewer hours than self-employed physicians.

Holding employee status constant, physicians in group practice actually work more hours annually than solo practice physicians, at least over the relevant range of practice size. Although statistically significant, the elasticity of hours with respect to practice size is only .01 at the mean

## TABLE 6-4

## WORK EFFORT REGRESSIONS: OFFICE HOURS

| Variables | Means | Eq. 1 |  | Eq. 2 |  | Eq. 3 |  |
|---|---|---|---|---|---|---|---|
|  |  | Coeff. | "t" | Coeff. | "t" | Coeff. | "t" |
| INTERCEPT | 1.00 | 6.414 | 31.22 | 6.439 | 31.09 | 7.361 | 13.15 |
| FEMALE | 0.07 | -0.077 | 1.62 | -0.058 | 1.18 | -0.077 | 1.62 |
| AGE1 | 48.74 | 0.041 | 5.07 | 0.040 | 4.93 | 0.037 | 4.66 |
| SQAGE1 | $2.53\text{x}10^{3}$ | $-4.3\text{x}10^{-4}$ | 5.50 | $-4.2\text{x}10^{-4}$ | 5.40 | $-3.9\text{x}10^{-4}$ | 5.12 |
| MARRIED | 0.91 | 0.021 | 0.51 | 0.025 | 0.59 | 0.016 | 0.39 |
| YGT10K | 0.36 | -0.076 | 3.00 | -0.075 | 2.98 | -0.076 | 3.07 |
| BOARD | 0.59 | -0.009 | 0.35 | -0.015 | 0.54 | -0.013 | 0.50 |
| FMG1 | 0.21 | 0.001 | 0.04 | $1.3\text{X}10^{-4}$ | 0.00 | 0.005 | 0.13 |
| WHITE | 0.85 | 0.044 | 1.08 | 0.046 | 1.14 | 0.060 | 1.51 |
| FP | 0.34 | 0.017 | 0.44 | 0.026 | 0.64 | 0.036 | 0.92 |
| INT | 0.35 | -0.138 | 3.47 | -0.141 | 3.52 | -0.064 | 1.59 |
| PED | 0.17 | 0.118 | 2.56 | 0.120 | 2.62 | 0.094 | 2.08 |
| MD | 7.59 |  |  | 0.002 | 1.80 | 0.002 | 2.11 |
| SQMD | 742.43 |  |  | $-7.0\text{x}10^{-6}$ | 1.82 | $-8.4\text{x}10^{-6}$ | 2.24 |
| SHARY | 0.10 |  |  | -0.045 | 1.14 | -0.039 | 1.01 |
| EMP | 0.17 |  |  | -0.095 | 2.56 | -0.096 | 2.66 |
| HMO | 0.17 |  |  | 0.022 | 0.64 | 0.038 | 1.11 |
| IPA | 0.13 |  |  | 0.047 | 1.29 | 0.064 | 1.79 |
| PPO | 0.10 |  |  | -0.012 | 0.29 | -0.017 | 0.41 |
| LPCMDMSA | 4.17 |  |  |  |  | -0.048 | 1.50 |
| LDPCINC | 9.08 |  |  |  |  | -0.097 | 1.64 |
| LPCTVOS | -1.53 |  |  |  |  | -0.102 | 6.84 |
| NE | 0.21 |  |  |  |  | -0.010 | 0.29 |
| SO | 0.31 |  |  |  |  | 0.099 | 3.15 |
| WS | 0.23 |  |  |  |  | 0.073 | 2.11 |
| $R^2$ |  | .10 |  | .10 |  | .16 |  |
| F/DOF |  | 11/999 |  | 8/992 |  | 8/986 |  |

practice size of 7.59 percent. As expected, physicians in group practices that share income equally work fewer hours than other physicians, although this result is not statistically significant.

Differences between alternative health plan (AHP) participants and non-participants were also insignificant. However, holding constant population characteristics, particularly region, IPA participants appear to work significantly more hours than non-participants and PPO participants (see equation 3). Physicians in poorer, physician-scarce areas, like the South, tend not to join IPAs, yet they tend to work 10% longer office hours than physicians in other areas, making physicians not participating in IPAs appear more productive. Holding constant regional factors shows that IPA participants are more productive than non-participants.

Given that IPA participants are more likely to be paid on a fee-for-service basis than, say, HMO participants, it is not surprising that they work longer hours. It is not clear however, why IPA participants work more hours than physicians not participating in any AHP, unless physicians choosing to participate in IPAs have higher preferences for income over leisure than other physicians. Similarly, we would expect HMO participants to show the lowest work effort since they are the most likely to be paid on a capitated basis. However, HMO participants appear to work 4 percent more hours annually than physicians not participating in an AHP, although this difference is not significant (see equation 3).

Holding constant demand characteristics and visit mix across settings also changed the magnitude of the coefficient on variables other than AHP participation. Internists no longer appear to work significantly less than GPs, probably because time spent in other settings is held constant. Indeed, in terms of total hours worked, internists work no less than GPs (see Section 6.3.4). A 6 percent higher office work effect for white physicians almost becomes significant when controlling for demand factors, probably because non-white physicians are over represented in the high work-effort South.

Physicians in physician-dense and wealthier areas appear to have 5 to 10 percent lower work efforts, although these results are not quite significant. Finally, physicians living in the South and West work 10% and 7% longer office hours respectively, even holding demand and physician availability constant.

### 6.3.4 Comparing Office and Total Work Effort

Table 6-5 compares work effort regressions for office hours versus total hours. On a total hours basis, female physicians appear to work 12 percent fewer hours annually, reflecting that they are much less likely than male physicians to locate in other settings than the office. While the effects of physician age are the same on office and total work effort, the effect of having an outside income is much smaller and insignificant on a total hours basis. Similarly, the difference in work effort between white and non-white physicians decreases in the total hours regression.

Neither specialty effects nor group size effects are significant on a total hours basis. This suggests that the effects of these variables on office work effort stem primarily from differences in physician settings for certain specialists and group practitioners.

Total work effort was positively related to the proportion of patient care activity taking place in non-office settings. Presumably, physicians seeking to increase their income do so by increasing their activity in non-office settings.

A smaller negative coefficient on LDPCINC in the total hours equation suggests that physicians in wealthier areas spend less time in the office setting than in other settings. By contrast, western physicians spend more time in the office than in other settings.

TABLE 6-5

WORK EFFORT REGRESSIONS: OFFICE HOURS VS. TOTAL HOURS

| Variables | Means | Office Hours | | Total Hours | |
|---|---|---|---|---|---|
| | | Coeff. | "t" | Coeff. | "t" |
| INTERCEPT | 1.00 | 7.361 | 13.15 | 7.70 | 15.79 |
| FEMALE | 0.07 | -0.077 | 1.62 | -0.117 | 2.83 |
| AGE | 48.74 | 0.037 | 4.66 | 0.035 | 5.02 |
| SQAGE | $2.53\times10^3$ | $-3.9\times10^{-4}$ | 5.12 | $-3.7\times10^{-4}$ | 5.62 |
| MARRIED | 0.91 | 0.016 | 0.39 | -0.015 | 0.43 |
| YGT10K | 0.36 | -0.076 | 3.07 | -0.031 | 1.43 |
| BOARD | 0.59 | -0.013 | 0.50 | -0.012 | 0.51 |
| FMG1 | 0.21 | 0.005 | 0.13 | 0.025 | 0.81 |
| WHITE | 0.85 | 0.060 | 1.51 | 0.034 | 0.99 |
| FP | 0.34 | 0.036 | 0.92 | 0.038 | 1.13 |
| INT | 0.35 | -0.064 | 1.59 | -0.015 | 0.41 |
| PED | 0.17 | 0.094 | 2.08 | 0.056 | 1.40 |
| MD | 7.59 | 0.002 | 2.11 | $5.9\times10^{-4}$ | 0.62 |
| SQMD | 742.43 | $-8.4\times10^{-6}$ | 2.24 | $-4.3\times10^{-6}$ | 1.32 |
| SHARY | 0.10 | -0.039 | 1.01 | -0.030 | -0.84 |
| EMP | 0.17 | -0.096 | 2.66 | -0.070 | 2.22 |
| HMO | 0.17 | 0.038 | 1.11 | -0.004 | 0.14 |
| IPA | 0.13 | 0.064 | 1.79 | 0.060 | 1.91 |
| PPO | 0.10 | -0.017 | 0.41 | -0.040 | 1.10 |
| LPCMDMSA | 4.17 | -0.048 | 1.50 | -0.045 | 1.62 |
| LDPCINC | 9.08 | -0.097 | 1.64 | -0.045 | 0.88 |
| LPCTVOS | -1.53 | -0.102 | 6.84 | 0.080 | 6.18 |
| NE | 0.21 | -0.010 | 0.29 | -0.026 | 0.82 |
| SO | 0.31 | 0.099 | 3.15 | 0.069 | 2.54 |
| WS | 0.23 | 0.073 | 2.11 | 0.028 | 0.93 |
| $R^2$ | | .16 | | .13 | |
| F/DOF | | 8/986 | | 7/986 | |

# APPENDIX A: DESCRIPTIVE PRODUCTIVITY RESULTS USING 1976-78 HCFA-NORC DATA

## A.1 Descriptive Results for Productivity Measures

To show variation in productivity among physicians, we first examined average annual productivity, intensity and work effort for all physicians. According to Table A-1, the average physician sees 3.6 patients per hour for 1,406 hours per year and has 4,842 visits per year.

The percentile values for the productivity measures in the top part of A-1 show wide variation around the means, especially for the intensity measure. Ten percent of all physicians see fewer than 1.1 patients per hour while another ten percent see more than 6.1 per hour. The median total productivity, intensity and work effort values (4,032, 3.2, and 1356 respectively) are all less than the means of these variables implying a left skew with some large outliers.

Examining annual productivity means by specialty in Table A-1 reveals that much of the productivity variation among physicians stems from specialty differences. Dermatologists have the most office visits per year (7,865) both because they have short visit lengths and because they are primarily office based, while neurosurgeons have the fewest (1,744 per year) because they work fewer hours in the office. Since surgeons make more hospital visits than other physicians, their work effort, measured in terms of office visits, is biased downward.

Along with dermatologists, allergists see the most patients per hour (4.8 and 4.5 respectively), while psychiatrists clearly see the fewest (1.2 patients per hour). The inverse of their intensity measures yields an average visit length of 13 minutes for dermatologists compared to 50 minutes for psychiatrists. These strikingly different visit lengths are clearly due to different specialty casemixes rather than different intensity levels.

Pediatricians, GPs, allergists and dermatologists appear to work the most office hours (1,766 per year) compared to neurosurgeons who only see patients in the office 715 hours per year on average. Although they are surgeons, ophthalmologists treat many patients in the office as well and therefore have a large number of office visits annually.

TABLE A-1. GENERAL DESCRIPTIVE STATISTICS ON PRODUCTIVITY MEASURES; 1976-78

| | Total Productivity V/Y | Intensity V/H | Work Effort H/Y | Number of Observations |
|---|---|---|---|---|
| All Specialists | 4842 | 3.6 | 1406 | 10,000 |
| Percentiles | | | | |
| 90 | 8781 | 6.1 | 2115 | |
| 75 | 6240 | 4.5 | 1764 | |
| 50 (median) | 4032 | 3.2 | 1386 | |
| 25 | 2205 | 2.0 | 966 | |
| 10 | 1320 | 1.1 | 662 | |
| Allergists (AL) | 6563 | 4.5 | 1604 | 361 |
| Cardiologists (CD) | 2872 | 2.6 | 1215 | 291 |
| Dermatologists (DM) | 7865 | 4.8 | 1653 | 358 |
| Gastroenterologists (GA) | 2694 | 2.5 | 1151 | 239 |
| GPs and FPs (GP) | 6653 | 4.3 | 1610 | 1412 |
| General Surgeons (GS) | 3143 | 4.1 | 844 | 1093 |
| Internists (IM) | 3804 | 2.8 | 1413 | 993 |
| Neurological Surgeons (NS) | 1744 | 2.6 | 715 | 298 |
| OB-GYNs (OBG) | 5069 | 4.1 | 1329 | 1241 |
| Ophthalmologists (OPT) | 5258 | 3.4 | 1602 | 421 |
| Orthopedic Surgeons (OS) | 4238 | 4.2 | 1104 | 350 |
| Otolaryngologists (ENT) | 5060 | 4.3 | 1241 | 361 |
| Pediatricians (PED) | 6528 | 3.8 | 1766 | 1099 |
| Psychiatrists (PSY) | 1809 | 1.2 | 1589 | 1160 |
| Urologists (URO) | 3220 | 3.9 | 963 | 323 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physician Surveys.

Pooling three years of productivity data yielded large enough sample sizes to compare 4 productivity groups as opposed to only 2 and 3 in the 1984-85 survey. Differences in mean annual productivity among the productivity quartiles can be seen in Table A-2. Visits per year of the least productive physicians in each specialty averaged 2,157 while the most productive specialists averaged four times as many, i.e., 8,449 visits per year. Clearly the difference would be exaggerated if quartiles were not created on a specialty-specific basis and say, surgeons and psychiatrists made up the lowest quartile while pediatricians and dermatologists made up the highest quartile.

Table A-2 also shows mean intensity and work effort components corresponding to the annual productivity quartiles. Intensity (V/H) varies far more than office work effort (H/Y) across quartiles: a 145.5% difference in visits per hour compared to the 53.0% difference in average hours per year. The 48.5% difference in hours worked per week compared to the 2.8% difference in weeks worked per year suggests that decreases in annual work effort stem mainly from physicians altering hours worked per week rather than working fewer weeks per year.

## A.2 Descriptive Results of Physician Productivity Determinants

Table A-3 compares practice, demand and personal physician characteristics across productivity groups based on all physicians regardless of specialty. Since these productivity groups are not adjusted for specialty differences, lower ones are dominated by physicians who work relatively fewer office hours (e.g. surgeons) and by physicians whose casemixes require longer visits (e.g. psychiatrists).

Despite confounding specialty effects, descriptive variables are generally consistent with theoretical expectations. Equipment costs and aides per physician more than double between lowest and highest annual productivity groups. (Equipment costs increase from $1,565 to $3,468 and aides increase from 1.7 to 3.5 across quartiles.)

The strong inverse relationship between office fees and annual productivity quartiles, while consistent with theoretical expectations, is probably overstated by the high psychiatrist office fees in low productivity quartiles and low GP office fees in high quartiles.

TABLE A-2. MEANS OF PHYSICIAN PRODUCTIVITY MEASURES FOR ALL SPECIALTIES BY TOTAL PRODUCTIVITY QUARTILES; 1976-78

| | Total Productivity | Intensity Component | Work Effort | | |
|---|---|---|---|---|---|
| | | | Total | Components | |
| | (V/Y) | (V/H) | (H/Y) | (H/W) | (W/Y) |
| Lowest Quartile | 2157 | 2.2 | 1116 | 23.9 | 46.7 |
| Low Quartile | 3886 | 3.2 | 1359 | 28.7 | 47.2 |
| High Quartile | 5243 | 3.9 | 1476 | 31.0 | 47.6 |
| Highest Quartile | 8449 | 5.4 | 1708 | 35.5 | 48.0 |
| % Difference between Lowest and Highest Quartile | 291.7% | 145.5% | 53.0% | 48.5% | 2.8% |

Sources: HCFA-NORC 1976, 1977 and 1978 Physician Surveys.

TABLE A-3. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: ALL PHYSICIANS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 1684 | 2654 | 2563 | 3231 | 2262 | 2624 | 2384 | 2920 | 1565 | 2426 | 2563 | 3468 |
| Aides per physician (#) | 1.9 | 2.5 | 2.9 | 3.3 | 2.2 | 2.7 | 2.8 | 3.0 | 1.7 | 2.3 | 2.8 | 3.5 |
| Office fee ($) | 23.10 | 17.40 | 16.59 | 16.45 | 18.48 | 18.18 | 17.40 | 17.80 | 22.60 | 18.95 | 16.77 | 14.98 |
| % Solo practice | 89.5 | 83.1 | 78.1 | 75.3 | 77.4 | 78.4 | 81.9 | 87.6 | 84.2 | 75.6 | 72.7 | 75.1 |
| % Incorporated | 36.0 | 44.7 | 51.3 | 55.8 | 53.9 | 47.0 | 44.8 | 44.1 | 39.5 | 48.3 | 49.9 | 49.9 |
| % Partnership | 3.7 | 6.4 | 7.1 | 6.8 | 4.8 | 6.6 | 6.5 | 6.1 | 4.4 | 5.4 | 7.1 | 6.9 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 61.8 | 56.6 | 55.2 | 56.8 | 65.9 | 58.2 | 52.3 | 54.7 | 65.4 | 60.8 | 54.8 | 50.9 |
| % Foreign graduates | 15.3 | 14.3 | 12.8 | 10.1 | 15.6 | 13.5 | 11.3 | 12.0 | 15.8 | 14.8 | 11.9 | 10.2 |
| % Female | 7.0 | 4.6 | 4.6 | 3.2 | 3.9 | 4.4 | 6.4 | 4.3 | 6.5 | 4.1 | 4.7 | 4.0 |
| Physician Age (yrs.) | 53 | 51 | 50 | 49 | 51 | 51 | 51 | 51 | 52 | 52 | 50 | 50 |
| % With Extra income $10,000 | 20.1 | 18.6 | 17.2 | 19.8 | 21.8 | 19.8 | 16.8 | 17.5 | 23.4 | 17.9 | 17.0 | 18.5 |
| % Currently married | 88.6 | 91.9 | 93.4 | 90.9 | 90.3 | 91.1 | 91.8 | 91.4 | 88.1 | 91.6 | 93.0 | 91.4 |
| % Without children | 45.6 | 40.8 | 35.2 | 36.5 | 39.3 | 43.9 | 37.2 | 37.3 | 43.3 | 44.2 | 34.3 | 36.6 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 225 | 184 | 169 | 153 | 192 | 183 | 176 | 177 | 226 | 191 | 172 | 146 |
| % Urban pop. | 85.5 | 80.5 | 77.3 | 74.3 | 82.6 | 79.8 | 78.6 | 76.2 | 86.3 | 81.7 | 79.3 | 70.8 |
| % Poor pop. | 14.8 | 15.5 | 14.9 | 16.1 | 14.7 | 14.9 | 16.0 | 15.4 | 14.4 | 15.3 | 14.2 | 17.0 |
| % Insured pop. | 85.2 | 89.4 | 89.6 | 88.1 | 91.1 | 88.1 | 87.6 | 86.0 | 86.8 | 89.7 | 89.0 | 86.9 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

Physicians in solo practice are more highly represented in the lowest annual productivity group (84% compared to 75%), suggesting that the economies of scale of group practice raise physician productivity. Since incorporation is associated with group practice, it is not surprising that a larger proportion of physicians seeing the most patients per year are incorporated.

Physicians in the high annual productivity quartile are less likely to be board certified or FMGs. This is a surprising result for board certified physicians whose additional training should enable them to both produce more efficiently than other physicians and attract more patients. Most likely the inverse result for this variable stems from confounding specialty effects (e.g., surgeons in the lowest quartile are more likely to be board certified than GPs in the highest.)

Table A-3 also shows physicians in the highest total productivity quartiles to be slightly younger on average. Oddly enough, this stems from older physicians working less intensively per hour than by working fewer hours, since the average physician age is a constant 51 across work effort quartiles. These results probably reflect the time it takes for a physician to build up a reputation and practice such that his peak work years occur in his early fifties. Both younger and older physicians are probably over-represented in the lowest work effort quartile, the former because of downtime inherent in a new practice and the latter because of stronger leisure preferences.

Specialty effects also confound productivity results for female physicians since women are concentrated in a few specialties like psychiatry and pediatrics. Hence, while female physicians appear to work slightly harder, this result simply reflects the greater number of office hours for pediatricians. When specialty is controlled for, females are found to work fewer hours (see Table A-4 below).

"Productive" physicians are generally married with children and are less likely to have an outside income of more than $10,000. Since most physicians with children are married, the positive relationship between productivity and marriage most likely reflects the presence of children and the need for extra income.

Demand characteristics, proxied by physicians per capita and urbanization, vary widely across physician productivity quartiles. Average physician- availability ratios are much lower for the highest total

TABLE A-4. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: ALL SPECIALTIES; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 2052 | 2388 | 2495 | 3292 | 2206 | 2363 | 2541 | 3116 | 1773 | 2254 | 2901 | 3377 |
| Aides per physician (#) | 2.1 | 2.6 | 2.7 | 3.2 | 2.3 | 2.6 | 2.8 | 3.1 | 2.0 | 2.5 | 2.8 | 3.4 |
| Office fee ($) | 18.62 | 17.80 | 18.13 | 17.17 | 18.01 | 17.94 | 17.77 | 18.01 | 18.44 | 18.30 | 17.82 | 17.12 |
| % Solo practice | 85.5 | 76.8 | 69.5 | 74.0 | 78.2 | 73.3 | 73.9 | 81.0 | 82.6 | 76.0 | 73.3 | 73.6 |
| % Incorporated | 34.5 | 45.6 | 52.7 | 56.8 | 43.4 | 48.1 | 50.1 | 47.6 | 34.0 | 47.3 | 52.4 | 56.6 |
| % Partnership | 4.3 | 6.5 | 7.9 | 5.4 | 4.9 | 6.2 | 6.3 | 6.8 | 4.9 | 6.2 | 6.3 | 6.8 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 53.8 | 57.0 | 61.5 | 57.9 | 56.2 | 59.1 | 59.3 | 55.5 | 55.0 | 58.7 | 60.0 | 57.1 |
| % Foreign graduates | 15.7 | 12.0 | 13.2 | 11.4 | 15.8 | 11.3 | 12.3 | 12.8 | 16.4 | 12.7 | 12.2 | 10.6 |
| % Female | 6.3 | 5.2 | 4.2 | 3.5 | 5.3 | 5.2 | 4.7 | 3.9 | 6.1 | 5.0 | 4.2 | 3.6 |
| Physician Age (yrs.) | 54 | 51 | 49 | 50 | 52 | 51 | 50 | 51 | 54 | 51 | 50 | 50 |
| % With Extra income $10,000 | 20.1 | 17.8 | 17.0 | 20.6 | 22.4 | 19.1 | 17.2 | 16.6 | 23.1 | 17.2 | 15.1 | 19.8 |
| % Currently married | 89.2 | 93.2 | 92.1 | 90.4 | 89.3 | 91.4 | 91.4 | 92.7 | 89.3 | 91.4 | 91.4 | 92.7 |
| % Without children | 48.2 | 40.5 | 32.5 | 35.4 | 49.9 | 38.4 | 35.1 | 33.1 | 49.9 | 38.4 | 35.1 | 33.1 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 204 | 180 | 179 | 162 | 192 | 178 | 178 | 179 | 205 | 186 | 172 | 162 |
| % Urban pop. | 82.6 | 79.1 | 79.1 | 76.1 | 82.4 | 79.8 | 77.6 | 77.0 | 83.6 | 81.3 | 77.2 | 74.2 |
| % Poor pop. | 15.3 | 15.0 | 15.6 | 15.4 | 15.2 | 15.1 | 15.2 | 15.8 | 15.0 | 14.6 | 15.9 | 15.7 |
| % Insured pop. | 87.7 | 88.2 | 88.4 | 88.3 | 88.8 | 88.4 | 88.1 | 87.1 | 88.2 | 89.1 | 88.3 | 86.8 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

productivity quartile: 146 per 100,000 population versus 226 per 100,000 population for the lowest quartile. Since physicians are disproportionately located in urban areas, it is not surprising that the least productive physicians are in more urban areas.

Since specialty effects can either obscure relationships or produce spurious results, we reconstructed the quartiles holding specialty mix constant (see Methods). Specialty-adjusted results in Table A-4 show significant differences from Table A-3 for variables describing office fees, board certification, and sex.

Although specialty effects are not a serious problem for aides and equipment costs, they appear to cause spurious results for office fees. The decrease in office fees across productivity quartiles in Table A-4 is only 7% (from $18.44 to $17.12) compared to the 34% decrease in Table A-3 where high psychiatrist fees were over-represented in the lowest quartile.

In contrast to Table A-3, board certification now appears positively related to productivity. Between 57% and 60% of physicians with above average annual productivity are board certified compared to only 55-59% of the physicians with below average productivity. Of course, other factors may still be obscuring this positive relationship.

While the most notable difference between Tables A-3 and A-4 was in board certification trend, the variations in annual productivity in personal characteristics like age, sex and family status become sharper in Table A-4. These sharper variations stem mainly from changes in the work effort component of annual productivity. For example, the greater work effort effects of female physicians reverse themselves in Table A-4 showing a 26% decline in the proportion of female physicians across work effort groups. Work effort also appears to decline slightly with age after holding specialty effects constant. While the one year difference in average age between highest and lowest work effort quartiles is statistically significant, the reduced intensity effect of older physicians still overshadows this work effort result.

Physician scarcity and urbanization varied more across quartiles before adjusting for specialty mix. Nevertheless, both are still inversely correlated with productivity decreasing 21% and 11%, respectively, across quartiles.

While Table A-4 adjusted productivity for specialty casemix differences, trends across quartile groups of smaller specialties may be obscured. Tables A-5 through A-19 present the results for each specialty individually. Tables A-5 through A-10 for GPs, internists, pediatricians, OBGs, psychiatrists and general surgeons provide descriptive trends for the largest specialties. Tables A-11 through A-14 follow with the results for more specialized surgeons (orthopedic surgeons, neurosurgeons, ophthalmologists, and urologists, respectively). Finally Tables A-15 through A-19 show results for the smaller medical subspecialties (gastroenterologists, cardiologists, otolaryngologists, allergists and dermatologists).

Comparing Table A-5 with A-4, it is apparent that GPs/FPs charge lower fees and use more aides and less equipment than other physicians on average. Also, a much stronger inverse relationship between age and work effort exists for GPs than for other physicians, possibly because they are older on average and more are cutting back on their practices.

Although internists provide services similar to GPs/FPs, they are more often board certified and in group practice and tend to be younger on average. Unlike the other primary care specialists, board certified internists appear less productive annually with only 46% of the most productive internists certified compared to 54% of the least productive certified. It is possible that certified internists are treating patients with more complicated problems requiring longer visits. Alternatively, demand factors might be confounding the relationship if board certified internists are predominately located in urban areas where competition is greater.

The smaller work effort of female physicians is evident when examining the specialties with relatively more females (e.g., pediatrics, and psychiatry). For example, the proportion of female physicians decreases from 22.4 to 14.1 percent across pediatrician work effort quartiles and from 14.8 to 11.6% across psychiatrist work effort groups.

Although psychiatrists differ greatly from other specialties (e.g. fewer aides, lower equipment costs, and higher fees), the trends in the descriptive variables across productivity quartiles are quite similar to other large specialties. By contrast physicians in the remaining large specialty, general surgery, actually vary quite differently across productivity groups than other specialists, particularly by personal characteristics (see Table A-10). The

TABLE A-5. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: GENERAL AND FAMILY PRACTITIONERS; 1977-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 1456 | 2112 | 2336 | 2819 | 1772 | 1931 | 2250 | 2810 | 1255 | 1541 | 3053 | 2996 |
| Aides per physician (#) | 2.3 | 2.8 | 3.1 | 3.8 | 2.6 | 3.0 | 3.1 | 3.4 | 2.1 | 2.8 | 3.3 | 3.8 |
| Office fee ($) | 13.66 | 14.60 | 14.29 | 13.58 | 13.56 | 14.43 | 14.19 | 14.02 | 13.80 | 14.52 | 14.10 | 13.70 |
| % Solo practice | 92.6 | 81.4 | 79.6 | 82.6 | 88.5 | 82.7 | 80.2 | 84.9 | 91.7 | 80.6 | 84.1 | 79.6 |
| % Incorporated | 17.3 | 32.6 | 37.2 | 40.6 | 23.4 | 34.5 | 35.0 | 34.8 | 13.9 | 34.9 | 36.6 | 42.6 |
| % Partnership | 3.4 | 7.6 | 8.5 | 5.5 | 5.1 | 6.9 | 6.8 | 6.1 | 4.8 | 6.4 | 5.1 | 8.7 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 17.5 | 26.0 | 34.0 | 25.9 | 17.4 | 24.3 | 30.6 | 30.2 | 14.5 | 28.4 | 29.0 | 30.6 |
| % Foreign graduates | 13.6 | 8.9 | 12.4 | 7.6 | 12.8 | 8.8 | 10.9 | 9.1 | 14.3 | 8.1 | 11.0 | 8.3 |
| % Female | 4.4 | 5.1 | 4.1 | 2.9 | 3.0 | 6.6 | 3.8 | 3.2 | 4.0 | 5.3 | 3.9 | 3.3 |
| Physician Age (yrs.) | 60 | 54 | 52 | 52 | 59 | 55 | 53 | 52 | 62 | 54 | 52 | 51 |
| % With Extra income $10,000 | 26.6 | 19.8 | 17.0 | 23.5 | 25.6 | 20.5 | 18.7 | 22.0 | 29.4 | 20.0 | 15.1 | 21.9 |
| % Currently married | 89.3 | 93.7 | 90.6 | 89.3 | 88.0 | 94.1 | 89.7 | 9.9 | 89.4 | 91.4 | 89.9 | 93.0 |
| % Without children | 68.1 | 53.4 | 42.6 | 46.3 | 67.4 | 54.0 | 46.9 | 42.1 | 74.9 | 50.1 | 45.6 | 39.3 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 165 | 147 | 126 | 118 | 151 | 139 | 133 | 134 | 165 | 149 | 121 | 119 |
| % Urban pop. | 73.7 | 70.0 | 65.3 | 64.0 | 72.7 | 70.7 | 66.4 | 63.5 | 74.4 | 73.5 | 64.3 | 60.5 |
| % Poor pop. | 16.4 | 15.4 | 19.0 | 17.2 | 15.3 | 16.6 | 17.5 | 18.2 | 16.5 | 14.5 | 18.8 | 17.9 |
| % Insured pop. | 87.8 | 88.5 | 86.8 | 86.3 | 88.3 | 86.8 | 87.7 | 86.9 | 88.1 | 88.8 | 87.6 | 85.1 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-6. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: INTERNISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 2330 | 2506 | 2807 | 2605 | 2524 | 2489 | 2239 | 2964 | 2017 | 3108 | 2317 | 2748 |
| Aides per physician (#) | 2.0 | 2.6 | 2.7 | 3.2 | 2.4 | 2.5 | 2.8 | 2.9 | 2.0 | 2.6 | 2.6 | 3.5 |
| Office fee ($) | 20.30 | 19.60 | 18.41 | 17.47 | 19.33 | 19.60 | 17.92 | 18.93 | 20.39 | 19.40 | 18.33 | 17.37 |
| % Solo practice | 82.8 | 75.4 | 75.0 | 77.8 | 83.9 | 67.6 | 72.9 | 86.5 | 81.0 | 76.5 | 78.1 | 76.0 |
| % Incorporated | 33.8 | 46.2 | 51.7 | 55.6 | 48.6 | 45.0 | 48.0 | 45.1 | 36.7 | 48.0 | 50.3 | 53.2 |
| % Partnership | 6.6 | 5.0 | 6.1 | 4.5 | 1.9 | 10.8 | 4.9 | 5.3 | 5.9 | 5.5 | 4.7 | 6.1 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 48.4 | 53.2 | 45.3 | 45.1 | 50.9 | 48.6 | 46.5 | 46.1 | 53.6 | 47.1 | 46.1 | 45.6 |
| % Foreign graduates | 17.4 | 17.9 | 18.4 | 21.7 | 23.8 | 17.6 | 13.5 | 19.5 | 17.9 | 22.7 | 18.9 | 14.5 |
| % Female | 8.0 | 4.6 | 4.5 | 3.2 | 5.1 | 4.5 | 6.2 | 4.7 | 7.1 | 4.5 | 3.8 | 4.9 |
| Physician Age (yrs.) | 53 | 51 | 50 | 50 | 51 | 50 | 50 | 51 | 51 | 52 | 50 | 50 |
| % With Extra income $10,000 | 18.1 | 17.7 | 19.7 | 15.2 | 25.1 | 18.8 | 13.6 | 13.4 | 27.4 | 12.9 | 11.1 | 20.2 |
| % Currently married | 86.5 | 96.7 | 93.9 | 92.5 | 95.1 | 90.5 | 93.2 | 90.3 | 90.8 | 93.1 | 92.0 | 92.6 |
| % Without children | 49.4 | 34.6 | 35.1 | 29.7 | 35.8 | 44.4 | 29.2 | 40.2 | 43.0 | 38.2 | 34.7 | 32.6 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 234 | 194 | 196 | 183 | 209 | 206 | 195 | 197 | 231 | 199 | 196 | 180 |
| % Urban pop. | 86.7 | 85.3 | 84.1 | 81.6 | 86.5 | 85.1 | 82.5 | 83.2 | 87.7 | 85.3 | 8.5 | 79.1 |
| % Poor pop. | 16.2 | 15.3 | 16.1 | 13.5 | 15.8 | 14.6 | 16.5 | 13.5 | 17.0 | 15.2 | 14.3 | 14.4 |
| % Insured pop. | 92.3 | 92.4 | 92.0 | 92.2 | 93.1 | 93.2 | 91.1 | 91.6 | 93.8 | 91.7 | 91.7 | 91.8 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-7. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: PEDIATRICIANS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 1181 | 1533 | 1600 | 1229 | 899 | 1426 | 1435 | 1776 | 1080 | 1212 | 1790 | 1432 |
| Aides per physician (#) | 2.3 | 2.5 | 2.9 | 3.0 | 2.2 | 2.6 | 2.9 | 3.0 | 2.1 | 2.4 | 2.8 | 3.3 |
| Office fee ($) | 14.94 | 14.40 | 14.09 | 13.78 | 14.60 | 14.41 | 14.25 | 13.96 | 14.85 | 14.81 | 14.35 | 13.25 |
| % Solo practice | 77.8 | 64.9 | 56.7 | 55.1 | 63.0 | 56.0 | 67.5 | 69.1 | 72.8 | 65.8 | 53.7 | 63.1 |
| % Incorporated | 25.9 | 40.1 | 44.9 | 50.9 | 31.2 | 46.4 | 40.8 | 42.5 | 24.7 | 37.9 | 44.1 | 54.2 |
| % Partnership | 10.5 | 13.8 | 12.8 | 16.7 | 14.6 | 15.6 | 9.2 | 14.2 | 12.4 | 12.6 | 16.5 | 11.9 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 61.0 | 71.9 | 78.3 | 73.2 | 68.1 | 71.6 | 70.7 | 73.1 | 61.1 | 72.2 | 77.8 | 72.5 |
| % Foreign graduates | 25.2 | 21.4 | 12.2 | 14.4 | 22.4 | 17.4 | 19.6 | 14.1 | 26.5 | 17.8 | 18.2 | 10.9 |
| % Female | 15.1 | 10.2 | 8.3 | 7.4 | 19.1 | 8.4 | 6.9 | 6.6 | 18.1 | 11.7 | 4.3 | 6.9 |
| Physician Age (yrs.) | 50 | 47 | 47 | 46 | 48 | 47 | 47 | 48 | 49 | 47 | 47 | 46 |
| % With Extra income $10,000 | 16.4 | 11.9 | 11.2 | 18.5 | 14.7 | 13.9 | 17.3 | 12.8 | 16.7 | 12.7 | 13.1 | 15.3 |
| % Currently married | 91.1 | 91.0 | 91.0 | 92.0 | 86.8 | 94.6 | 91.1 | 92.8 | 87.3 | 93.0 | 91.9 | 93.7 |
| % Without children | 35.2 | 29.5 | 27.8 | 25.7 | 34.5 | 27.3 | 29.1 | 28.4 | 33.0 | 31.1 | 29.3 | 25.3 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 201 | 178 | 188 | 181 | 195 | 179 | 187 | 187 | 201 | 191 | 179 | 178 |
| % Urban pop. | 84.2 | 81.9 | 84.7 | 81.9 | 85.4 | 84.1 | 82.1 | 81.2 | 85.1 | 84.5 | 82.9 | 80.2 |
| % Poor pop. | 12.9 | 15.3 | 13.4 | 17.0 | 14.6 | 14.8 | 14.6 | 15.3 | 13.7 | 12.6 | 16.3 | 16.1 |
| % Insured pop. | 81.9 | 83.5 | 87.0 | 82.7 | 82.2 | 83.6 | 85.3 | 83.8 | 80.5 | 84.2 | 85.4 | 84.1 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-8. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: OBSTETRICIANS AND GYNECOLOGISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 1922 | 2089 | 2544 | 3237 | 1841 | 3011 | 2037 | 2923 | 1550 | 2200 | 2551 | 3659 |
| Aides per physician (#) | 2.2 | 2.8 | 2.9 | 3.1 | 2.4 | 2.8 | 2.9 | 2.9 | 2.2 | 2.7 | 3.0 | 3.3 |
| Office fee ($) | 20.28 | 19.61 | 19.64 | 18.19 | 19.69 | 19.93 | 18.86 | 19.40 | 20.65 | 20.02 | 18.92 | 18.1 |
| % Solo practice | 73.5 | 65.7 | 49.0 | 48.6 | 61.9 | 59.2 | 54.0 | 60.4 | 73.6 | 59.5 | 47.8 | 50.7 |
| % Incorporated | 49.6 | 62.3 | 71.1 | 77.0 | 57.7 | 66.2 | 69.7 | 67.8 | 48.9 | 61.8 | 74.4 | 78.3 |
| % Partnership | 5.8 | 7.2 | 8.8 | 6.3 | 7.4 | 7.5 | 6.8 | 6.9 | 5.5 | 8.4 | 8.5 | 6.4 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 69.1 | 76.0 | 73.6 | 80.9 | 72.1 | 75.7 | 73.9 | 77.4 | 70.4 | 76.3 | 74.4 | 78.6 |
| % Foreign graduates | 20.9 | 15.9 | 15.2 | 13.6 | 23.7 | 15.0 | 15.0 | 11.4 | 23.5 | 16.4 | 12.7 | 11.6 |
| % Female | 7.3 | 7.8 | 5.5 | 5.9 | 7.8 | 5.1 | 8.8 | 4.3 | 8.7 | 5.1 | 6.2 | 5.8 |
| Physician Age (yrs.) | 54 | 49 | 47 | 47 | 51 | 49 | 48 | 48 | 54 | 48 | 47 | 46 |
| % With Extra income $10,000 | 22.0 | 16.3 | 17.1 | 19.2 | 21.6 | 19.9 | 21.2 | 12.1 | 24.0 | 16.3 | 17.8 | 15.6 |
| % Currently married | 88.8 | 91.9 | 94.6 | 91.1 | 90.8 | 90.6 | 91.6 | 93.8 | 87.9 | 93.7 | 95.2 | 90.2 |
| % Without children | 46.8 | 31.2 | 24.5 | 30.7 | 41.7 | 34.1 | 25.7 | 30.0 | 50.1 | 29.1 | 26.0 | 25.3 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 215 | 174 | 185 | 169 | 199 | 183 | 181 | 179 | 215 | 183 | 178 | 163 |
| % Urban pop. | 85.0 | 80.6 | 83.2 | 80.5 | 85.0 | 83.5 | 80.8 | 80.2 | 86.7 | 82.4 | 82.2 | 77.7 |
| % Poor pop. | 12.0 | 16.6 | 15.5 | 16.1 | 16.0 | 15.0 | 13.8 | 15.3 | 12.5 | 15.7 | 13.9 | 18.5 |
| % Insured pop. | 87.0 | 87.3 | 88.0 | 89.1 | 88.3 | 88.4 | 88.3 | 86.5 | 87.9 | 88.6 | 87.2 | 87.8 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-9. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: PSYCHIATRISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 538 | 385 | 557 | 948 | 840 | 476 | 597 | 477 | 503 | 521 | 536 | 819 |
| Aides per physician (#) | 1.1 | 0.9 | 1.2 | 1.8 | 1.3 | 1.1 | 1.2 | 1.3 | 1.1 | 1.1 | 1.3 | 1.5 |
| Office fee ($) | 40.92 | 35.94 | 39.06 | 36.19 | 37.02 | 35.80 | 38.33 | 41.71 | 37.31 | 38.99 | 37.83 | 38.10 |
| % Solo practice | 98.3 | 94.9 | 92.2 | 88.8 | 94.5 | 94.1 | 94.3 | 92.4 | 97.1 | 94.8 | 94.8 | 88.4 |
| % Incorporated | 32.1 | 30.4 | 37.9 | 47.0 | 28.6 | 27.1 | 37.9 | 52.1 | 22.2 | 32.5 | 36.8 | 55.3 |
| % Partnership | 0.0 | 2.4 | 1.7 | 2.6 | 1.1 | 1.6 | 1.2 | 2.4 | 0.3 | 1.2 | 2.2 | 2.8 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 75.4 | 87.7 | 83.4 | 80.2 | 80.2 | 83.6 | 83.3 | 79.3 | 81.8 | 81.8 | 79.5 | 83.4 |
| % Foreign graduates | 12.7 | 8.4 | 15.3 | 14.5 | 14.8 | 16.0 | 8.4 | 11.6 | 14.8 | 13.7 | 9.6 | 12.1 |
| % Female | 12.9 | 10.9 | 8.9 | 6.0 | 9.5 | 12.5 | 9.1 | 8.1 | 13.1 | 1.0 | 9.8 | 5.7 |
| Physician Age (yrs.) | 52 | 50 | 49 | 50 | 52 | 49 | 50 | 50 | 52 | 50 | 49 | 50 |
| % With Extra income $10,000 | 16.5 | 9.1 | 20.5 | 17.9 | 18.3 | 16.9 | 15.0 | 17.7 | 16.5 | 14.8 | 15.8 | 21.3 |
| % Currently married | 80.6 | 84.5 | 86.9 | 88.0 | 77.5 | 85.4 | 87.3 | 87.6 | 80.2 | 78.0 | 86.7 | 93.5 |
| % Without children | 41.0 | 40.2 | 29.5 | 38.0 | 44.0 | 34.5 | 40.4 | 34.9 | 44.6 | 37.0 | 36.7 | 35.9 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 270 | 286 | 273 | 212 | 269 | 258 | 259 | 260 | 277 | 276 | 257 | 235 |
| % Urban pop. | 91.0 | 91.5 | 90.6 | 84.1 | 88.0 | 89.5 | 89.1 | 91.2 | 90.4 | 90.8 | 89.1 | 87.5 |
| % Poor pop. | 13.9 | 13.6 | 14.4 | 14.6 | 14.7 | 16.0 | 11.4 | 14.3 | 13.9 | 14.8 | 14.0 | 13.8 |
| % Insured pop. | 74.6 | 73.5 | 74.9 | 82.3 | 75.5 | 78.9 | 75.9 | 74.6 | 74.2 | 77.0 | 76.4 | 77.4 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-10. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: GENERAL SURGEONS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| **Practice Characteristics:** | | | | | | | | | | | | |
| Equipment costs ($) | 1922 | 1694 | 1540 | 3146 | 1277 | 1619 | 2087 | 3234 | 1463 | 1486 | 2073 | 3258 |
| Aides per physician (#) | 1.9 | 2.1 | 2.4 | 2.6 | 1.7 | 2.0 | 2.5 | 2.9 | 1.7 | 1.9 | 2.3 | 3.3 |
| Office fee ($) | 17.11 | 16.05 | 16.26 | 15.28 | 16.81 | 16.13 | 16.22 | 15.91 | 17.61 | 15.59 | 16.01 | 15.75 |
| % Solo practice | 85.3 | 79.7 | 67.0 | 76.2 | 75.8 | 73.6 | 72.0 | 85.6 | 82.8 | 74.7 | 70.9 | 77.9 |
| % Incorporated | 42.5 | 55.5 | 51.2 | 67.4 | 55.0 | 59.8 | 52.6 | 45.2 | 49.8 | 49.2 | 60.8 | 54.7 |
| % Partnership | 3.4 | 4.5 | 9.2 | 3.8 | 7.6 | 5.1 | 5.0 | 4.2 | 3.1 | 7.5 | 5.4 | 5.8 |
| **Physician Characteristics:** | | | | | | | | | | | | |
| % Board certified | 67.7 | 68.9 | 58.4 | 65.1 | 72.0 | 75.1 | 64.4 | 45.2 | 72.1 | 69.6 | 68.9 | 46.6 |
| % Foreign graduates | 22.6 | 18.3 | 15.5 | 14.4 | 15.6 | 11.7 | 20.7 | 24.3 | 23.3 | 12.6 | 13.6 | 21.5 |
| % Female | 1.4 | 1.5 | 1.6 | 1.3 | 1.7 | 1.9 | 1.2 | 0.7 | 0.4 | 2.9 | 1.5 | 0.9 |
| Physician Age (yrs.) | 52 | 51 | 51 | 51 | 49 | 51 | 51 | 54 | 50 | 51 | 51 | 53 |
| % With Extra income $10,000 | 20.3 | 20.3 | 17.4 | 23.4 | 22.8 | 21.6 | 19.5 | 17.5 | 22.3 | 19.8 | 18.3 | 20.8 |
| % Currently married | 94.6 | 92.3 | 95.4 | 91.9 | 94.9 | 92.5 | 93.7 | 93.2 | 94.2 | 92.2 | 93.0 | 94.5 |
| % Without children | 42.6 | 40.8 | 33.7 | 32.2 | 31.2 | 38.2 | 40.6 | 39.7 | 35.6 | 37.7 | 42.7 | 34.6 |
| **Demand Characteristics:** | | | | | | | | | | | | |
| MDs per 100,000 pop. | 194 | 165 | 167 | 140 | 179 | 168 | 169 | 155 | 198 | 172 | 153 | 144 |
| % Urban pop. | 81.1 | 76.2 | 77.1 | 72.1 | 82.0 | 77.2 | 73.6 | 74.6 | 85.0 | 78.4 | 70.0 | 73.1 |
| % Poor pop. | 15.3 | 15.7 | 14.9 | 17.5 | 16.9 | 14.3 | 15.7 | 16.2 | 12.8 | 17.2 | 15.3 | 17.0 |
| % Insured pop. | 91.3 | 91.3 | 92.4 | 90.8 | 92.7 | 93.5 | 91.6 | 87.8 | 92.4 | 92.8 | 92.3 | 88.3 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-11. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: ORTHOPEDIC SURGEONS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 5210 | 3761 | 3137 | 6014 | 5486 | 3529 | 4435 | 4421 | 3861 | 5057 | 5239 | 3852 |
| Aides per physician (#) | 2.8 | 3.3 | 3.2 | 3.2 | 2.8 | 2.9 | 3.2 | 3.6 | 2.7 | 3.1 | 3.1 | 3.6 |
| Office fee ($) | 18.46 | 19.43 | 17.20 | 15.98 | 17.21 | 18.38 | 16.99 | 18.70 | 19.04 | 18.14 | 17.38 | 16.39 |
| % Solo practice | 75.7 | 48.1 | 39.9 | 50.1 | 55.9 | 51.3 | 50.4 | 61.3 | 67.9 | 57.9 | 40.5 | 47.5 |
| % Incorporated | 61.1 | 78.0 | 78.6 | 82.8 | 75.0 | 67.3 | 84.6 | 72.4 | 57.3 | 80.4 | 81.4 | 81.1 |
| % Partnership | 3.7 | 3.4 | 13.2 | 1.7 | 4.8 | 11.1 | 3.1 | 3.2 | 6.2 | 2.4 | 10.9 | 2.8 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 80.7 | 89.0 | 84.7 | 91.8 | 84.6 | 91.1 | 93.8 | 75.7 | 83.2 | 86.4 | 92.4 | 83.9 |
| % Foreign graduates | 8.3 | 3.1 | 10.3 | 7.2 | 10.7 | 2.4 | 5.5 | 10.8 | 9.2 | 8.2 | 3.2 | 8.4 |
| % Female | 2.4 | 1.1 | 1.1 | 3.5 | 3.1 | 0.0 | 2.2 | 2.6 | 1.5 | 1.5 | 1.0 | 4.1 |
| Physician Age (yrs.) | 50 | 46 | 45 | 47 | 47 | 48 | 47 | 46 | 50 | 46 | 45 | 47 |
| % With Extra income $10,000 | 18.0 | 13.5 | 14.6 | 15.7 | 18.7 | 18.3 | 11.7 | 12.2 | 15.9 | 17.9 | 16.8 | 11.9 |
| % Currently married | 91.3 | 96.9 | 95.8 | 90.8 | 92.6 | 92.9 | 96.9 | 92.1 | 90.8 | 89.8 | 99.3 | 93.0 |
| % Without children | 24.7 | 24.1 | 27.4 | 23.5 | 29.2 | 24.1 | 24.6 | 20.7 | 26.5 | 29.1 | 18.3 | 24.8 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 194 | 175 | 187 | 186 | 205 | 176 | 170 | 190 | 210 | 193 | 170 | 175 |
| % Urban pop. | 84.4 | 79.7 | 83.3 | 81.4 | 85.0 | 81.6 | 80.1 | 82.2 | 85.4 | 84.8 | 79.0 | 79.7 |
| % Poor pop. | 19.6 | 10.1 | 13.0 | 11.7 | 10.4 | 18.1 | 11.1 | 15.5 | 17.6 | 12.6 | 12.4 | 11.0 |
| % Insured pop. | 92.6 | 91.6 | 90.7 | 92.0 | 92.0 | 90.5 | 92.5 | 91.7 | 91.9 | 92.1 | 91.7 | 90.3 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-12. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: NEUROLOGICAL SURGEONS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| **Practice Characteristics:** | | | | | | | | | | | | |
| Equipment costs ($) | 2343 | 3018 | 2046 | 5984 | 1929 | 2240 | 2854 | 6277 | 1624 | 2260 | 3471 | 6257 |
| Aides per physician (#) | 1.8 | 2.0 | 2.1 | 2.2 | 1.7 | 1.9 | 1.9 | 2.6 | 1.8 | 1.8 | 1.9 | 2.7 |
| Office fee ($) | 24.83 | 23.19 | 21.19 | 20.15 | 22.00 | 20.16 | 22.30 | 24.35 | 24.01 | 20.87 | 21.37 | 22.8 |
| % Solo practice | 62.3 | 58.8 | 60.8 | 45.2 | 45.3 | 63.9 | 47.9 | 71.0 | 53.2 | 59.3 | 49.0 | 65.1 |
| % Incorporated | 72.8 | 65.0 | 75.4 | 77.7 | 74.4 | 73.1 | 64.6 | 79.0 | 78.0 | 62.7 | 71.4 | 80.7 |
| % Partnership | 4.7 | 7.1 | 9.2 | 6.8 | 11.3 | 6.3 | 9.9 | 0.0 | 4.0 | 10.1 | 8.7 | 5.0 |
| **Physician Characteristics:** | | | | | | | | | | | | |
| % Board certified | 68.7 | 71.5 | 67.2 | 78.1 | 80.1 | 77.9 | 71.3 | 56.4 | 77.8 | 75.9 | 65.4 | 65.4 |
| % Foreign graduates | 8.5 | 15.6 | 11.7 | 5.9 | 9.8 | 7.4 | 14.5 | 9.2 | 14.3 | 4.4 | 16.6 | 6.7 |
| % Female | 2.3 | 0.0 | 3.5 | 3.2 | 5.0 | 0.0 | 0.0 | 4.4 | 3.8 | 0.0 | 2.0 | 4.1 |
| Physician Age (yrs.) | 52 | 48 | 47 | 45 | 47 | 49 | 49 | 48 | 50 | 49 | 48 | 45 |
| % With Extra income $10,000 | 11.9 | 14.0 | 12.0 | 24.2 | 22.8 | 23.2 | 7.8 | 5.6 | 13.7 | 21.0 | 16.0 | 10.3 |
| % Currently married | 86.6 | 90.1 | 84.2 | 92.2 | 88.0 | 87.5 | 93.4 | 83.8 | 88.8 | 88.9 | 87.3 | 86.7 |
| % Without children | 47.8 | 31.2 | 34.8 | 16.1 | 25.4 | 36.0 | 30.0 | 38.0 | 40.5 | 27.7 | 31.5 | 27.8 |
| **Demand Characteristics:** | | | | | | | | | | | | |
| MDs per 100,000 pop. | 203 | 214 | 210 | 188 | 200 | 195 | 221 | 198 | 203 | 216 | 200 | 190 |
| % Urban pop. | 88.4 | 87.6 | 85.6 | 85.4 | 88.7 | 86.8 | 85.4 | 85.8 | 89.1 | 87.7 | 85.6 | 84.0 |
| % Poor pop. | 14.5 | 12.4 | 16.2 | 13.4 | 16.1 | 12.3 | 14.7 | 13.3 | 12.4 | 13.3 | 18.4 | 13.0 |
| % Insured pop. | 92.8 | 90.7 | 93.4 | 92.3 | 92.7 | 91.9 | 95.0 | 89.9 | 93.0 | 93.0 | 93.3 | 89.8 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-13. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: OPHTHALMOLOGISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| **Practice Characteristics:** | | | | | | | | | | | | |
| Equipment costs ($) | 3036 | 7081 | 6598 | 7324 | 4292 | 5892 | 5909 | 7748 | 3354 | 5063 | 7019 | 8773 |
| Aides per physician (#) | 2.0 | 2.7 | 2.9 | 3.8 | 2.5 | 3.1 | 2.7 | 3.0 | 2.0 | 2.4 | 3.2 | 3.8 |
| Office fee ($) | 20.28 | 19.21 | 19.83 | 18.30 | 20.76 | 18.03 | 19.50 | 19.50 | 20.17 | 20.69 | 19.30 | 17.40 |
| % Solo practice | 88.8 | 75.6 | 75.9 | 81.9 | 78.5 | 72.0 | 87.0 | 87.0 | 84.4 | 83.2 | 72.2 | 83.3 |
| % Incorporated | 24.0 | 52.0 | 59.0 | 65.3 | 43.2 | 51.7 | 53.0 | 50.2 | 26.1 | 47.5 | 60.6 | 67.4 |
| % Partnership | 3.5 | 8.3 | 4.3 | 2.7 | 5.9 | 4.7 | 3.2 | 4.5 | 3.8 | 5.7 | 5.3 | 3.4 |
| **Physician Characteristics:** | | | | | | | | | | | | |
| % Board certified | 72.5 | 76.9 | 87.3 | 85.1 | 79.5 | 82.8 | 81.3 | 77.2 | 77.8 | 74.5 | 84.4 | 85.0 |
| % Foreign graduates | 9.3 | 4.6 | 3.9 | 3.2 | 5.0 | 3.7 | 4.4 | 8.5 | 7.8 | 6.1 | 4.2 | 2.7 |
| % Female | 3.6 | 2.7 | 4.1 | 2.2 | 2.8 | 2.6 | 3.7 | 3.5 | 4.5 | 3.0 | 3.8 | 1.0 |
| Physician Age (yrs.) | 54 | 49 | 48 | 48 | 54 | 49 | 49 | 47 | 55 | 50 | 47 | 48 |
| % With Extra income $10,000 | 21.8 | 19.9 | 13.0 | 26.0 | 25.8 | 21.6 | 23.2 | 10.3 | 22.2 | 23.7 | 14.0 | 22.6 |
| % Currently married | 90.1 | 91.4 | 93.6 | 89.7 | 86.8 | 90.8 | 95.2 | 91.0 | 89.4 | 92.1 | 93.1 | 89.7 |
| % Without children | 55.5 | 41.3 | 21.8 | 35.4 | 62.2 | 30.3 | 37.1 | 27.5 | 64.3 | 37.5 | 21.3 | 29.5 |
| **Demand Characteristics:** | | | | | | | | | | | | |
| MDs per 100,000 pop. | 208 | 189 | 187 | 186 | 208 | 178 | 183 | 203 | 210 | 196 | 183 | 178 |
| % Urban pop. | 84.9 | 83.2 | 80.9 | 82.2 | 86.2 | 82.0 | 83.7 | 79.2 | 86.5 | 83.6 | 80.4 | 80.2 |
| % Poor pop. | 15.5 | 14.2 | 12.8 | 14.0 | 13.8 | 11.9 | 13.5 | 18.3 | 13.0 | 13.8 | 15.6 | 13.9 |
| % Insured pop. | 82.2 | 86.5 | 86.5 | 85.5 | 86.8 | 85.3 | 85.0 | 83.1 | 83.2 | 88.8 | 85.5 | 83.2 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-14. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: UROLOGISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 2138 | 1624 | 2371 | 2807 | 2327 | 1947 | 2404 | 2278 | 1628 | 2045 | 2943 | 2344 |
| Aides per physician (#) | 2.1 | 2.2 | 2.3 | 2.2 | 1.9 | 2.1 | 2.4 | 2.4 | 1.8 | 2.1 | 2.3 | 2.4 |
| Office fee ($) | 16.77 | 18.32 | 16.05 | 16.87 | 16.98 | 16.80 | 17.10 | 16.91 | 17.37 | 16.66 | 17.01 | 16.76 |
| % Solo practice | 68.1 | 59.2 | 47.3 | 59.1 | 57.0 | 54.4 | 49.8 | 71.0 | 59.4 | 63.3 | 60.9 | 45.6 |
| % Incorporated | 61.5 | 70.0 | 70.2 | 65.0 | 62.8 | 70.8 | 75.8 | 55.9 | 61.8 | 68.6 | 68.3 | 66.6 |
| % Partnership | 2.1 | 7.2 | 15.3 | 5.0 | 7.0 | 1.6 | 8.9 | 11.7 | 5.8 | 3.6 | 5.2 | 16.9 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 70.8 | 84.6 | 80.5 | 79.5 | 76.2 | 81.7 | 84.8 | 71.1 | 71.4 | 85.5 | 81.9 | 74.9 |
| % Foreign graduates | 16.4 | 14.1 | 9.0 | 6.1 | 16.1 | 2.6 | 13.2 | 11.6 | 14.1 | 13.6 | 11.2 | 5.2 |
| % Female | 1.2 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 |
| Physician Age (yrs.) | 46 | 49 | 46 | 50 | 47 | 46 | 50 | 48 | 45 | 49 | 47 | 49 |
| % With Extra income $10,000 | 15.1 | 18.1 | 14.4 | 21.6 | 12.8 | 16.9 | 12.1 | 26.4 | 15.7 | 10.5 | 17.0 | 28.1 |
| % Currently married | 92.4 | 95.5 | 89.4 | 94.8 | 92.1 | 88.2 | 93.8 | 97.9 | 88.7 | 97.0 | 88.5 | 100.0 |
| % Without children | 23.2 | 38.8 | 28.9 | 36.3 | 36.6 | 25.0 | 30.8 | 33.0 | 25.9 | 34.0 | 34.8 | 31.4 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 201 | 204 | 199 | 182 | 197 | 197 | 200 | 188 | 212 | 184 | 204 | 180 |
| % Urban pop. | 83.2 | 80.2 | 78.1 | 83.0 | 86.1 | 79.2 | 79.3 | 78.9 | 84.2 | 79.6 | 82.7 | 77.0 |
| % Poor pop. | 17.5 | 15.0 | 12.0 | 13.2 | 18.1 | 11.8 | 12.0 | 13.6 | 16.7 | 15.1 | 13.7 | 10.5 |
| % Insured pop. | 93.5 | 92.1 | 94.6 | 92.9 | 94.0 | 94.0 | 93.1 | 92.6 | 93.7 | 93.3 | 93.4 | 93.2 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-15. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: GASTROENTEROLOGISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARITLES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 2904 | 2899 | 4214 | 2772 | 3126 | 2851 | 3463 | 3405 | 3023 | 2584 | 4404 | 2756 |
| Aides per physician (#) | 2.0 | 2.2 | 2.3 | 2.8 | 1.6 | 2.4 | 2.7 | 2.7 | 1.7 | 2.0 | 2.7 | 2.9 |
| Office fee ($) | 22.91 | 20.60 | 19.56 | 20.93 | 20.13 | 20.33 | 21.61 | 21.26 | 21.17 | 20.54 | 21.91 | 19.80 |
| % Solo practice | 63.3 | 65.3 | 53.2 | 57.6 | 62.8 | 61.5 | 49.9 | 65.9 | 71.4 | 61.1 | 55.6 | 50.7 |
| % Incorporated | 64.7 | 59.9 | 67.1 | 62.1 | 67.9 | 59.7 | 64.8 | 61.2 | 58.8 | 68.8 | 72.1 | 53.7 |
| % Partnership | 9.5 | 10.4 | 11.8 | 11.6 | 9.3 | 4.2 | 14.4 | 14.7 | 10.4 | 3.3 | 7.5 | 23.2 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 66.3 | 74.6 | 63.5 | 69.8 | 86.8 | 59.5 | 74.2 | 51.9 | 76.5 | 76.3 | 60.0 | 61.5 |
| % Foreign graduates | 27.0 | 10.8 | 13.0 | 8.5 | 14.4 | 16.4 | 7.6 | 19.7 | 27.8 | 10.9 | 13.7 | 3.8 |
| % Female | 0.0 | 0.0 | 4.0 | 5.1 | 3.7 | 2.7 | 1.6 | 1.8 | 3.6 | 2.7 | 1.6 | 1.8 |
| Physician Age (yrs.) | 46 | 45 | 43 | 47 | 42 | 45 | 45 | 49 | 42 | 45 | 47 | 47 |
| % With Extra income $10,000 | 13.9 | 10.8 | 10.3 | 8.0 | 9.4 | 15.6 | 7.3 | 11.0 | 13.3 | 7.6 | 9.3 | 12.0 |
| % Currently married | 93.2 | 94.8 | 93.5 | 95.4 | 95.8 | 84.8 | 100.0 | 95.3 | 92.4 | 93.6 | 95.1 | 96.7 |
| % Without children | 17.0 | 21.7 | 17.3 | 26.2 | 13.4 | 25.8 | 23.7 | 21.3 | 19.4 | 16.5 | 26.4 | 21.2 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 236 | 203 | 205 | 223 | 237 | 213 | 205 | 211 | 226 | 224 | 218 | 196 |
| % Urban pop. | 92.1 | 89.0 | 88.6 | 89.3 | 90.3 | 90.1 | 87.9 | 90.6 | 88.2 | 90.9 | 94.2 | 85.0 |
| % Poor pop. | 9.4 | 20.4 | 18.8 | 11.0 | 13.5 | 18.3 | 14.8 | 14.1 | 11.9 | 15.8 | 16.6 | 15.2 |
| % Insured pop. | 92.7 | 95.3 | 89.4 | 92.5 | 93.1 | 90.7 | 91.7 | 93.8 | 93.2 | 92.9 | 90.9 | 92.4 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-16. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: CARDIOLOGISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| **Practice Characteristics:** | | | | | | | | | | | | |
| Equipment costs ($) | 3858 | 3157 | 3195 | 3606 | 2431 | 3384 | 3612 | 4517 | 3218 | 3247 | 3445 | 4140 |
| Aides per physician (#) | 2.2 | 2.5 | 2.4 | 2.9 | 2.0 | 2.3 | 2.6 | 3.0 | 1.9 | 2.5 | 2.6 | 2.9 |
| Office fee ($) | 23.71 | 22.12 | 20.52 | 18.62 | 21.53 | 20.40 | 21.64 | 21.63 | 22.60 | 23.62 | 19.70 | 19.20 |
| % Solo practice | 80.3 | 80.2 | 55.8 | 73.9 | 56.5 | 79.7 | 70.0 | 76.8 | 68.5 | 72.2 | 74.0 | 70.4 |
| % Incorporated | 55.7 | 60.3 | 66.9 | 70.1 | 68.2 | 59.2 | 70.1 | 55.8 | 54.3 | 66.4 | 67.4 | 65.7 |
| % Partnership | 3.5 | 2.0 | 6.4 | 0.8 | 6.9 | 4.0 | 1.2 | 2.1 | 4.9 | 4.9 | 3.4 | 0.7 |
| **Physician Characteristics:** | | | | | | | | | | | | |
| % Board certified | 69.3 | 76.1 | 72.8 | 62.3 | 65.4 | 73.1 | 73.6 | 70.0 | 68.6 | 78.8 | 68.8 | 66.4 |
| % Foreign graduates | 5.6 | 11.8 | 21.2 | 15.0 | 10.1 | 21.4 | 17.3 | 3.5 | 8.1 | 9.2 | 20.8 | 15.1 |
| % Female | 4.5 | 7.4 | 2.4 | 0.0 | 3.4 | 2.8 | 5.7 | 2.4 | 4.3 | 5.0 | 4.3 | 0.7 |
| Physician Age (yrs.) | 49 | 49 | 48 | 51 | 47 | 49 | 48 | 51 | 48 | 47 | 49 | 51 |
| % With Extra income $10,000 | 12.0 | 19.5 | 25.9 | 18.3 | 24.9 | 14.7 | 10.0 | 23.7 | 11.8 | 28.0 | 16.5 | 16.5 |
| % Currently married | 94.5 | 97.1 | 81.8 | 87.1 | 82.9 | 93.8 | 89.0 | 96.0 | 92.0 | 94.0 | 83.8 | 91.6 |
| % Without children | 34.4 | 35.2 | 20.4 | 33.2 | 23.3 | 31.8 | 32.0 | 34.9 | 25.9 | 31.9 | 34.6 | 28.9 |
| **Demand Characteristics:** | | | | | | | | | | | | |
| MDs per 100,000 pop. | 270 | 205 | 196 | 183 | 207 | 202 | 208 | 240 | 229 | 244 | 201 | 179 |
| % Urban pop. | 90.2 | 90.1 | 85.9 | 80.5 | 87.6 | 86.8 | 85.1 | 88.3 | 91.7 | 89.0 | 84.4 | 81.9 |
| % Poor pop. | 15.0 | 12.8 | 16.3 | 13.4 | 13.8 | 16.7 | 13.4 | 14.2 | 14.4 | 9.9 | 22.8 | 11.9 |
| % Insured pop. | 92.4 | 93.6 | 92.8 | 93.7 | 95.0 | 93.9 | 91.3 | 92.9 | 93.9 | 93.0 | 93.9 | 92.1 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-17. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: OTOLARYNGOLOGISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 2732 | 3944 | 3072 | 8244 | 3675 | 3684 | 7403 | 3956 | 2896 | 2853 | 4598 | 8279 |
| Aides per physician (#) | 2.4 | 3.1 | 3.3 | 3.5 | 3.0 | 3.0 | 3.1 | 3.2 | 2.5 | 2.8 | 3.5 | 3.6 |
| Office fee ($) | 18.63 | 17.92 | 16.71 | 18.26 | 16.92 | 18.63 | 17.70 | 18.46 | 17.54 | 17.77 | 19.12 | 17.36 |
| % Solo practice | 84.5 | 66.1 | 80.0 | 61.8 | 64.5 | 72.8 | 72.7 | 83.1 | 74.9 | 72.1 | 76.0 | 70.0 |
| % Incorporated | 45.9 | 58.0 | 57.7 | 70.7 | 73.3 | 61.4 | 55.7 | 43.1 | 57.6 | 58.4 | 55.5 | 61.9 |
| % Partnership | 9.1 | 8.5 | 5.5 | 7.4 | 7.2 | 3.9 | 7.8 | 12.3 | 6.6 | 8.1 | 8.2 | 8.1 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 71.9 | 74.8 | 79.1 | 80.0 | 80.6 | 79.2 | 73.5 | 12.8 | 70.9 | 82.8 | 77.7 | 75.3 |
| % Foreign graduates | 10.4 | 10.1 | 6.5 | 2.1 | 11.8 | 2.1 | 3.6 | 11.2 | 11.6 | 8.6 | 5.9 | 1.9 |
| % Female | 5.8 | 4.9 | 0.8 | 2.6 | 1.6 | 5.8 | 1.5 | 4.9 | 4.1 | 3.6 | 2.3 | 3.7 |
| Physician Age (yrs.) | 55 | 48 | 49 | 46 | 48 | 47 | 50 | 53 | 53 | 48 | 47 | 50 |
| % With Extra income $10,000 | 6.4 | 18.1 | 17.5 | 17.3 | 5.9 | 17.6 | 21.3 | 14.1 | 9.2 | 11.6 | 16.2 | 21.9 |
| % Currently married | 87.1 | 98.0 | 98.0 | 85.7 | 91.9 | 95.5 | 88.1 | 91.6 | 90.0 | 98.5 | 88.5 | 89.4 |
| % Without children | 47.5 | 21.5 | 30.3 | 20.3 | 26.6 | 20.0 | 34.8 | 38.4 | 43.9 | 22.3 | 17.1 | 35.8 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 205 | 201 | 161 | 178 | 174 | 182 | 194 | 195 | 196 | 179 | 187 | 181 |
| % Urban pop. | 84.4 | 84.8 | 80.1 | 79.5 | 87.5 | 79.5 | 78.8 | 82.6 | 84.8 | 84.4 | 82.4 | 76.8 |
| % Poor pop. | 14.2 | 18.8 | 11.6 | 14.1 | 13.4 | 11.3 | 18.1 | 17.4 | 13.5 | 14.2 | 17.5 | 15.1 |
| % Insured pop. | 89.6 | 92.7 | 93.5 | 91.0 | 92.4 | 90.7 | 92.0 | 91.6 | 90.7 | 92.4 | 90.7 | 92.7 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-18. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: ALLERGISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 2544 | 3044 | 2499 | 2209 | 2180 | 2119 | 2182 | 3556 | 2299 | 2713 | 2714 | 2616 |
| Aides per physician (#) | 3.8 | 4.4 | 4.0 | 4.0 | 3.4 | 4.0 | 4.0 | 4.6 | 3.7 | 4.0 | 4.3 | 4.1 |
| Office fee ($) | 18.81 | 17.46 | 16.94 | 15.15 | 17.01 | 17.29 | 16.83 | 17.30 | 18.51 | 18.21 | 16.33 | 15.37 |
| % Solo practice | 70.8 | 84.7 | 73.1 | 90.3 | 81.1 | 75.8 | 79.4 | 82.2 | 71.4 | 78.0 | 75.3 | 93.8 |
| % Incorporated | 47.1 | 41.9 | 51.0 | 59.0 | 41.4 | 56.1 | 46.9 | 52.9 | 49.3 | 33.8 | 53.9 | 61.6 |
| % Partnership | 7.2 | 8.2 | 5.2 | 2.1 | 3.2 | 5.8 | 11.9 | 2.4 | 6.4 | 8.8 | 7.9 | 0.2 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 51.2 | 56.8 | 63.3 | 61.6 | 53.4 | 67.3 | 52.6 | 65.7 | 58.7 | 64.1 | 61.6 | 57.2 |
| % Foreign graduates | 7.8 | 9.7 | 3.3 | 12.1 | 8.9 | 14.4 | 5.3 | 4.8 | 7.0 | 10.1 | 7.6 | 8.4 |
| % Female | 5.7 | 8.9 | 2.9 | 6.6 | 12.4 | 4.1 | 4.6 | 3.6 | 6.1 | 5.1 | 9.5 | 3.9 |
| Physician Age (yrs.) | 53 | 53 | 56 | 55 | 59 | 51 | 54 | 52 | 55 | 53 | 54 | 54 |
| % With Extra income $10,000 | 20.4 | 20.3 | 34.9 | 26.3 | 35.9 | 26.4 | 8.8 | 25.2 | 26.5 | 20.7 | 16.8 | 31.9 |
| % Currently married | 89.2 | 84.3 | 96.2 | 94.3 | 92.7 | 89.6 | 89.0 | 91.8 | 90.8 | 84.3 | 94.8 | 93.3 |
| % Without children | 45.5 | 42.1 | 47.5 | 51.7 | 61.5 | 39.2 | 47.4 | 40.5 | 50.8 | 34.1 | 51.8 | 48.4 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 217 | 194 | 209 | 181 | 203 | 188 | 199 | 210 | 206 | 211 | 196 | 188 |
| % Urban pop. | 85.8 | 84.9 | 89.9 | 88.7 | 89.2 | 87.9 | 84.0 | 87.6 | 85.4 | 88.1 | 87.7 | 88.1 |
| % Poor pop. | 15.3 | 11.5 | 13.1 | 11.7 | 12.7 | 12.3 | 16.7 | 10.8 | 15.3 | 9.4 | 14.4 | 11.7 |
| % Insured pop. | 87.0 | 86.8 | 86.7 | 85.1 | 85.2 | 83.7 | 86.0 | 89.9 | 85.9 | 88.4 | 85.6 | 85.7 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

TABLE A-19. PHYSICIAN CHARACTERISTICS OF PRODUCTIVITY GROUPS: DERMATOLOGISTS; 1976-78

| | INTENSITY (V/H) QUARTILES | | | | WORK EFFORT (H/Y) QUARTILES | | | | ANNUAL PRODUCTIVITY (V/Y) QUARTILES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST | LOWEST | LOW | HIGH | HIGHEST |
| Practice Characteristics: | | | | | | | | | | | | |
| Equipment costs ($) | 1901 | 1488 | 1819 | 3950 | 2917 | 1728 | 2131 | 2471 | 1621 | 1772 | 2166 | 3967 |
| Aides per physician (#) | 2.4 | 3.0 | 3.1 | 3.8 | 2.5 | 3.1 | 3.0 | 3.8 | 2.2 | 2.9 | 3.1 | 4.3 |
| Office fee ($) | 17.86 | 17.41 | 16.22 | 16.73 | 17.26 | 17.35 | 16.99 | 16.56 | 17.78 | 16.58 | 17.48 | 16.27 |
| % Solo practice | 95.7 | 86.1 | 85.1 | 72.6 | 90.0 | 75.5 | 87.8 | 85.9 | 90.6 | 86.5 | 82.7 | 77.5 |
| % Incorporated | 29.6 | 45.0 | 50.5 | 55.6 | 26.0 | 51.4 | 60.9 | 43.6 | 24.4 | 50.8 | 52.8 | 55.3 |
| % Partnership | 3.5 | 3.9 | 5.0 | 8.7 | 2.6 | 8.4 | 1.3 | 6.0 | 0.5 | 4.8 | 7.5 | 6.0 |
| Physician Characteristics: | | | | | | | | | | | | |
| % Board certified | 78.7 | 66.6 | 83.9 | 85.7 | 79.5 | 80.3 | 73.3 | 81.9 | 74.7 | 76.7 | 81.5 | 83.0 |
| % Foreign graduates | 11.0 | 5.0 | 1.3 | 3.7 | 5.0 | 3.5 | 6.8 | 5.8 | 6.5 | 8.4 | 2.6 | 3.1 |
| % Female | 15.5 | 4.2 | 3.7 | 4.6 | 7.9 | 5.9 | 4.2 | 10.0 | 12.2 | 4.6 | 8.7 | 1.7 |
| Physician Age (yrs.) | 48 | 48 | 50 | 49 | 52 | 49 | 48 | 46 | 49 | 50 | 46 | 50 |
| % With Extra income $10,000 | 12.7 | 15.2 | 13.3 | 24.1 | 25.4 | 11.6 | 15.1 | 11.6 | 16.3 | 13.4 | 16.8 | 20.1 |
| % Currently married | 91.7 | 93.2 | 89.0 | 86.2 | 79.3 | 95.7 | 95.4 | 91.0 | 87.5 | 90.3 | 91.4 | 92.1 |
| % Without children | 28.8 | 35.3 | 38.1 | 44.5 | 63.0 | 31.6 | 24.5 | 25.3 | 37.4 | 43.6 | 29.9 | 32.0 |
| Demand Characteristics: | | | | | | | | | | | | |
| MDs per 100,000 pop. | 186 | 201 | 188 | 194 | 224 | 174 | 205 | 165 | 205 | 195 | 186 | 180 |
| % Urban pop. | 87.5 | 85.1 | 85.4 | 87.1 | 90.3 | 85.9 | 86.2 | 82.5 | 88.5 | 86.8 | 85.9 | 83.5 |
| % Poor pop. | 9.7 | 13.6 | 14.0 | 13.8 | 15.7 | 11.9 | 12.2 | 12.1 | 12.9 | 12.2 | 11.5 | 15.2 |
| % Insured pop. | 87.1 | 90.4 | 86.6 | 89.2 | 87.1 | 86.8 | 89.5 | 90.4 | 86.9 | 88.5 | 90.4 | 87.9 |

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

most notable exception is the trend in physician age across quartiles. In fact, general surgeons in the highest work effort quartile are 5 years older than those in the lowest on average. Again, this result probably stems from the time it takes to build up a good reputation and large practice. On the other hand, older general surgeons might be decreasing their productivity by performing less surgery and spending more time in the office, thereby, appearing more productive using our office visit measure.

As the specialty sizes become smaller in Tables A-11 through A-19, relationships between productivity and the descriptive variables diverge more often from the aggregate results. These differences are more likely a result of smaller sample sizes (e.g., for female neurosurgeons) than of actual differences among specialists, however.

Table A-20 summarizes the directions of trends in practice, demand and personal physician characteristics across annual productivity quartiles by specialty. Clearly, the largest number of ambiguous results are found among the smallest specialties (e.g. allergists, gastroenterologists, and neurosurgeons). However, some variables maintain a strong, consistent relationship with productivity across all specialties regardless of sample size. Aides per physician enhance productivity consistently across all specialties while more physicians per capita are consistently associated with lower productivity. Higher equipment costs, rural location and incorporation are also associated with high productivity for almost all specialties.

On the other hand, board certification effects vary the most by specialty. This variation most likely stems from the confounding of negative casemix effects on productivity with positive demand effects for specialty care.

TABLE A-20. SUMMARY OF PRACTICE, PHYSICIAN AND DEMAND EFFECTS ON PHYSICIAN PRODUCTIVITY BY SPECIALTY; 1976-78

| | AL | CD | DM | GA | GP | GS | IM | NS | OBG | OPT | OS | ENT | PED | PSY | URO | ALL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Practice Characteristics: | | | | | | | | | | | | | | | | |
| Equipment costs ($) | + | + | + | 0 | + | + | + | + | + | + | + | + | + | + | + | + |
| Aides per physician (#) | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Office fee ($) | - | - | 0 | 0 | 0 | - | - | 0 | - | - | - | 0 | - | 0 | - | - |
| % Solo practice | + | + | - | - | - | - | - | + | - | - | - | - | - | - | 0 | - |
| % Incorporated | + | + | + | + | + | + | + | 0 | + | + | + | + | + | + | + | + |
| % Partnership | 0 | - | + | 0 | + | + | 0 | 0 | + | 0 | 0 | + | + | + | + | + |
| Physician Characteristics: | | | | | | | | | | | | | | | | |
| % Board certified | - | 0 | + | - | + | - | - | - | + | + | + | 0 | + | 0 | 0 | + |
| % Foreign graduates | 0 | + | - | - | - | 0 | - | 0 | - | - | - | - | - | - | - | - |
| % Female | - | 0 | - | - | - | 0 | - | 0 | - | - | + | - | - | - | - | - |
| Physician Age (yrs.) | 0 | 0 | 0 | + | - | + | - | - | - | - | - | - | - | - | + | - |
| % With Extra income $10,000 | 0 | + | + | 0 | - | - | - | 0 | - | 0 | - | + | 0 | + | + | - |
| % Currently married | 0 | - | + | + | + | 0 | + | - | + | + | + | 0 | + | + | + | + |
| % Without children | 0 | + | - | 0 | - | + | - | - | - | - | 0 | - | - | - | + | - |
| Demand Characteristics: | | | | | | | | | | | | | | | | |
| MDs per 100,000 pop. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| % Urban pop. | 0 | - | - | 0 | - | - | - | - | - | - | - | - | - | - | - | - |
| % Poor pop. | 0 | 0 | 0 | + | + | + | - | + | + | + | - | + | + | 0 | - | + |
| % Insured pop. | 0 | 0 | + | 0 | - | 0 | - | 0 | 0 | 0 | 0 | 0 | + | + | 0 | 0 |

+ = Positive trend
0 = Ambiguous trend
- = Negative trend

Sources: HCFA-NORC 1976, 1977 and 1978 Physicians Surveys.

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